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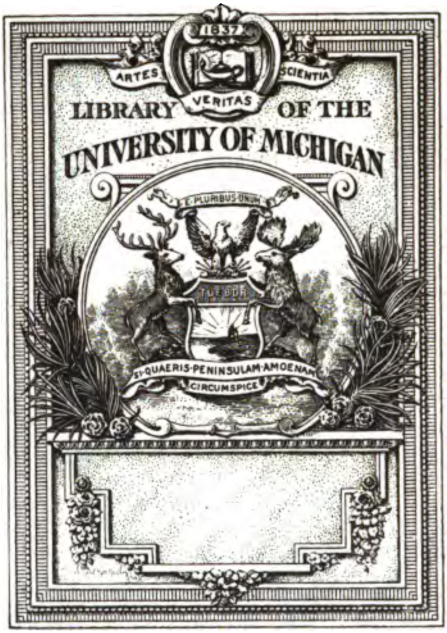
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THE PERICOSMIC THEORY

—OF—

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Physical Existence and its Sequel

PRELIMINARY TO

COSMOLOGY AND PHILOSOPHY PROPER.

BY

GEORGE STEARNS.

Common-sense and Reason are the exclusive means of finite intelligence.

PUBLISHED BY THE AUTHOR.
PRINTED BY WOOD BROTHERS, HUDSON, MASS.
1888.

PROLEGOMENA.

The one whole theme of *Science Proper* is MUNDANE EXISTENCE, the ANTERIOR CAUSE and ULTERIOR USE of which are conceptively emergent as the biune theme of *Philosophy Proper*.

The only mode of finite knowledge is *conviction*—a suscipient assurance of truth for which the Author of Nature and Parent of Mentality is exclusively responsible. Therefore all knowledge is absolute, and whatever is known to any sentient being is knowable in the same sense, and only in the same sense, to all sentient beings, in order as each shall become intellectively competent.

Existence comprises only whatever is *made to be*—the products of causation. Whatever is of necessity is eternal, ubiquitous, and immutable.

Mentality is finite, but ever-progressive; its Parent, THE INFINITE MIND.

Purchased 10-27-37

DEDICATION.

The germ of the theory to which this book is committed was the express opinion of certain notable scientists that the physical cause of gravity may in time be identified with the ethereal medium of light. When the writer first entertained this partially-conventional thought, he had no conception of the world's rotation as a unit, nor of the Ether as an atom, which, together with several minor attributes of the pericosm, have been subsequently found indispensable to its fitness to serve as the agent of gravity. In view of this history, and as a signal of the author's sense of personal dependence on the humanitary resources of intelligence, he is minded to dedicate this volume of his lucubrations during the last five years —

To all votaries of Science Proper,
and
To all tentative abettors of Philosophy Proper,
the finale of whose calling is
THE TELEOLOGY OF MUNDANE EXISTENCE.

PREFACE.

The subject of this book is dual, as purported by its title. *The Pericosmic Theory* is strictly scientific, being deduced from the positive data of astronomic observation by means of mathematical processes according to geometrical principles. But, while it is in harmony with the rudiments of physical science heretofore elaborated and conventionally accepted, it claims to be an original discovery as to the outlines of cosmic evolution in a sense more determinate and express than has formerly been apprehended by cosmologic inquirers.

Many phenomena of the physical world have long been regarded as inveterately mysterious, entailing problems the solution of which has seemed unpropitious, if not impossible, whereof the following specifications are representative, namely: The physical cause of gravity, momentum, inertia, and chemical action; Kepler's third law of planetary motion; the varying distance of the Earth and other planets from the Sun; how planetary rotation obtains; why the Moon rotates but once in a lunation; how nebulæ are formed and indued with axial rotation; why the orbital motion of planets is not retarded by the Ether's resistance; whether the medium of light be finite or infinite in extension. The Pericosmic Theory supplies a rational answer to each of these queries, and is ancillary to the solution of diverse other problems incidental to the partial development of physical science. It also refutes certain assumptions of scientistic speculation, as for example, that the luminiferous Ether is a species of Matter; that inertia, momentum, and gravity are inherent properties of Matter; that the Sun and other solar orbs move in orbits; that the orbits of planets are ellipsoidal; at the same time, supplying the only and all-sufficient reason for the indisputable fact that the orbits of comets are extremely elliptical. Yet, notwithstanding these and other emendations of conventional science, the Pericosmic Theory affiliates the Nebular Hypothesis — not only affiliates, but substantiates its validity by complementing its astronomic scope. That is to say, the Nebular Hypothesis as advocated by Laplace and more lately by Spencer, inchoates with an existing nebular as the antecedent of our Solar System, to which it applies almost exclusively; whereas the Pericosmic Theory applies to the whole stellar world, inchoating with the rotating pericosm which includes the evolution of nebulæ themselves from the prime reservoir of diffuse Matter, thus comprising —

1. The dual structure of the physical frame of Nature — the Ether a fast receptacle of Matter.

2. That the ethereal vehicle of Matter is an atom — an indivisible unit of concentric force.

3. That the medium of light is also the physical agent of gravity, as it can be only with the axial rotation of its volume, by which means Matter is indued with vehicular motion, the diametric difference of this, and of orbital motion, being the genetic cause of planetary rotation.

These three constituents of the Pericosmic Theory are individually and collectively essential to the order of physical existence and the process of cosmic evolution.

To ignore one of them is fatal to any attempted rationale of gravity, momentum, inertia, or any other of the aforesaid elements of physical existence; whereas with them all, together with whatever is germane to their exposition, it is believed that the Pericosmic Theory will suffice to eliminate mystery from the domain of physical science, that is within the purlieus of finite ratiocination. Is it sheer enthusiasm which incites the thought that it may also be the harbinger of what hereafter shall bear to be called *Philosophy*, without a derisive inkling of metaphysics?

As to the *Sequel* of this theory, what should it be but *to solve the problem of existence?* — that is, to discover what this world is good for beyond the sphere of mundane evolution. I would not say with the somber muse of a religious poet that "an undevout astronomer is mad;" but I must think that an asophical scientist is superficial; that is, one who investigates natural phenomena without a question as to their ultra-mundane significance. The Pericosmic Theory is radically suggestive in this direction. It is uniquely apt to dispel the notion that Matter is eternal, or that physical force is self-sustained. The conception of atoms as globules of concentric force and of the Ether as an atom, implies their dependence on an ulterior Power distinct from either yet relatively common to both. It also suppresses the verbal insinuation of their absolute indestructibility. The same, as to their rotary motion, which cannot be self-wrought. The concept of force as born of its manifestations in Nature and in Art is that of a power produced by some agent and sustained continuously by continuity of its inceptive agency. As the core of corporeity, both material and ethereal, and as the instigator of motion, physical force in all its guises must be perpetually created. What is obtrusively manifest in respect of light, heat, and all universal modes of motion, is equally true of things apparently statuesque, like the pyramids of Egypt. There is but one modality of causation relevant to corporeal stability or endurance, and that is the incessant creation of force. The argument is not long from this datum to the conclusion that organic energy in the process of natural causation hinges on the volition of its supernatural agent; and hence ensues *Theism,* entailing by deduction therefrom all that is rationally desirable.

GEORGE STEARNS.

Rockbottom, Mass., Aug. 30, 1888.

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THE PERICOSMIC THEORY.

CHAPTER I.

THE MYSTERY OF GRAVITY.

It is notorious that the word "attraction" is generally so employed in the literature of science as to purport the physical cause of gravity. Yet no expositor of physics has attempted to demonstrate that part of the theory which this item of its terminology denotes; unless privately, to be convinced of its falsity. On what principle, then, has the deceptive vogue obtained? Can the agents of this apparent dissimulation render a better reason therefor than that assigned by its original exemplifier (Newton), who adopted a misnomer of his own thought, and tolerated the "notion of attraction" merely as "a convenient means of regarding the subject?" Here is the sole gist of their exculpation. But even this plausible excuse is inadequate; since the word *gravitation* expresses all that is phenomenally known of the subject, whereas the word "attraction" signifies fictitiously more than is known, or rather what is known to be false. All know that matter gravitates, but *why* it gravitates is an open question which the talk of attraction insidiously and mischievously forecloses.

However, Newton's patronage of that provisional appellation was ingenuous and discriminate ; which is hardly putative of his nominal disciples, the majority of whom have thus far conserved the hasty designation of his thought without ever mentioning his later protest against its unqualified application. This protest is still extant as an item of correspondence, wherein he wrote very earnestly : "You sometimes speak of gravity as essential and inherent to matter. Pray, do not ascribe that notion to me, for the cause of gravity is what I do not pretend to know." But that prayer has been very generally ignored, or else viciously unheeded. Theorists, ostensibly Newtonian, seem to have conspired ever since the demise of Newton, which occurred 160 years ago, to embezzle the influence of his name in support of the very "notion" which he so strenuously renounced. In fact, of all the reputed votaries of physical science, so far as I have been able to learn, less than half a dozen have made good their claim to exemption from the foregoing indictment. These are well-known expositors of science proper, whose professional careers have been fairly signalized by success. It is proper to say, however, that in relation to the rationale of gravity, they have declared themselves purely agnostic, in the vein of Newton's protest cited above ; and this fact is what substantiates *their* claim to be respected as the genuine advocates and expounders of his superb discovery, which the loose talk of his would-be disciples about "the Newtonian theory of gravtiy" tends only to obscure. It was not *that* — the *principle* according to which gravity obtains — but *the law of gravitation*, the gist of which was yet to be conceived; and if in formulating *this law* he employed the word *attraction*, he soon detected his error and did what he could to cancel it.

It may not be generally known that Mr. Herbert Spencer has deliberately and unequivocally classed himself with the few eminent scientists who side with Newton in repudiating "the notion of attraction" as identified with gravity. In Vol. II. p. 409, *Principles of Psychology*, this remark occurs:

"Mr. Mill says that Newton held an ethereal medium to be a necessary implication of observed facts; but that it is not now held to be a necessary implication. I do not think, however, that scientific men 'have at last learnt to conceive the sun *attracting* the earth without any intervening fluid;' any more than they have learnt to 'conceive the sun *illuminating* the earth without some such medium.' The most that can be said is that they have given up attempting to conceive how gravitation results. If, however, an astronomer avowed that he could conceive gravitative force as exercised through space absolutely void, my private opinion would be that he mistook the nature of conception."

"Would gravitation have any existence if there were but one particle in the universe, or does it suddenly come into existence when a second particle appears? Is it an attribute of matter, or is it due to something between the particles of matter?"

These two double questions are taken from an article in *Chambers's Encyclopedia* (supposed to have been written by Balfour Stewart). They are consistent with no implicit faith in "the notion of attraction;" and the latter of the two implies an inkling of the pertinent truth, which Dr. Grove also insinuates in a single instance in his essay on "The Correlation of Physical Forces," thus:

"Would two bodies gravitate toward each other in empty space, if space can be empty? The notion that they would is founded on the theory of attraction, which Newton himself repudiated, further than as a means of regarding the subject."

The implied inference from *ipse dixit* which this quotation involves is somewhat equivocal; for what is here called a "theory" Newton called a "notion" and treated as a figment. Dr. Grove was in a quandary, which a slightly different view of the subject, such as Dr. Faraday excogitated, might have prevented. In an essay of the latter on "The Conservation of Force," as if responding to both parties cited above, this eminent physicist remarked:

"For my own part, many considerations urge my mind toward the idea of a cause of gravity which is not resident in the particles of matter merely, but constantly in them and in all space."

To say that was almost to hit the nail on the head. Nevertheless, the same thinker wrote afterward:

"As to the gravitating force, I do not presume to say that I have the least idea what occurs in two particles when their power of mutually approaching each other is changed by their being placed at different distances; but I have a strong conviction, through the influence on my mind of the doctrine of conservation, that there is a change; and that the phenomena resulting from the change will probably appear some day as the result of careful research."

The drift of Faraday's argument is, that the mask of gravity by the notion of physical attraction conflicts with the cosmic dynamic principle whereof gravity is a species; that thus self-impugned, the conceit of attraction is exploded. He maintains the deductive judgment—

"That there should be a power of gravitation existing by itself, having no relation to the other natural powers and no respect to the law of the conservation of force, is as little likely as that there should be a principle of levity as well as of gravity. . . . . . So we must strive to learn more of this outstanding power, and endeavor to avoid any definition of it which is incompatible with the principle of force generally, for all the phenomena of nature lead us to believe that the great and governing law is one. I would much rather incline to believe that bodies affecting each other by gravitation act by lines of force of definite amount or *by an ether pervading all space*, than admit that the conservation of force could be dispensed with."

The phrase "by an ether pervading all space," which I have italicized as significant, but which he wrote with indifference, suggests the rare possibility of hitting the nail on its head without knowing it. But I must say that Faraday was more expectant than any of his compeers in the line of inquiry here treated of.

Some three years ago I cut from a newspaper the subjoined bit of a reported lecture by Prof. C. A. Young, the reputable occupant of the astronomic chair in Princeton College.

" Do not understand me at all as saying that there is no mystery about the planets' motions. There is just the one single mystery—gravitation—and it is a very profound one. How it is that an atom of matter can attract another atom, no matter how great the disturbance, no matter what intervening substance there may be ; how it will act upon it, or at least behave as if it acted upon it, I do not know, I cannot tell. Whether they are *pushed together by means of an intervening ether*, or what is the action, I cannot understand."

Another instance of blurting the truth unawares, as denoted by my italics. Such an avowal as overlays this seemingly unpurposed suggestion is commendable for the frankness and fidelity to conviction by which it must have been prompted; and if not so appreciable as an announcement of successful research, its compensation is assured by its incitement to docility of aspiration, which it is wise to cherish and every functionary of popular education should cultivate as an essential conduit of intelligence. If all the reputed spokesmen of science proper would act their special parts as well as did Professor Young in the instance adverted to, by telling the credulous world precisely *what they know*, beyond which they merely guess, as to the physical cause of gravity, I fancy the tables would be turned, and that the list of scientists who side with Newton in rejecting the surreptitious "notion" as unscientific would shortly outnumber its half-earnest supporters.

But the issue of such an ordeal would not be final. The negative truth here sought is brought to light by a process of reasoning from other data. I have cited several documentary affirmations of personal conviction that the conceit of physical attraction is inexplicable. And to this testimony of five unimpeachable witnesses there is postively no counteracting evidence. For I dare say if all the nominal abettors of the said vulgar notion were summoned to this court of negative inquest, their undisputed depositions would verge to a tally with that of the younger Herschel, who in all his writings adverted to gravitation only as "that mystery of mysteries." How differs the mysterious from the inexplicable? Yet Sir John constantly plied the policy of supposititious explication, practically blind to the fact that the mystery of gravity is only aggravated by misconceit of its process. So, too, even Newton seems never to have asked himself why it should be more "convenient" to regard a subject in the fictitious light of unwarrantable assumption than in the apprehended murk of mystery. Yet his virtual reply to all the foregoing queries of his aptest disciples, shows that he came nearer than any of them to comprehending the principle of their common seeking. I am indebted to Faraday for the following citation from Newton's third letter to Bentley, wherein Sir Isaac abjured the figment of material attraction which some of his contemporaries too willingly imputed to him. There is no mistaking the import of his labored expression in these two sentences:

"That gravity should be innate, inherent and essential to matter, so that one body may act upon another at a distance, through a vacuum without the mediation of anything else by and through which their action and force may be conveyed from one to another, is to me so great an absurdity, that I believe no man who has in philosophical matters a competent faculty of thinking, can ever fall into it. Gravity must be caused by an agent, acting constantly according to certain laws; but whether this agent be material or immaterial, I have left to the consideration of my readers."

"There you have it plain and flat." Newton saw that the notion of physical attraction is *absurd.* He did not reject it for being inexplicable, but because he discerned in it the lineaments of impossibility; for whatever is absurd is impossible. According to his view of the matter, bodies fall when unsupported, not because the earth pulls them down, but in effect of being pushed downward by an invisible and to him unknown agency, the substantive nature and *modus agendi* of which nothing but his supposititious theory of light prevented him from conceiving. But since

Newton's day an important discovery has been made through which the fact of gravitation may be rationly accounted for. This item of physical science pertains to "the luminiferous ether," whose ascertained dynamic properties verify its fitness to serve as the secondary cause of gravity.

CHAPTER II.

THE PERICOSMIC ETHER.

There is a certain supersensible substance whose attributes and agencies are distinct from those of Matter, but on whose relation to Matter all the physical operations of Nature depend. The character and even the existence of this unique substance are known only by inference from the ascertained consistence of light. The entity to which this logical outcome of experimental science pertains has been provisionally named "the Ether."

Until within about half a century of past time, light itself was generally supposed to be material. Newton advocated what is called the corpuscular theory of light; that bodies become nominally self-luminous by emitting particles of a subtile species of matter, vaguely suggested by the term "caloric," whose congeneric phases were known as light and heat. It is hardly needful to say here that the notions of light and heat as material entities are now antiquated, having been supplanted by a tenable theory whereby both are identified with specific modes of motion. It is a lesson of rational instinct that motion implies something moved. Heat is a motion of matter—an oscillation of corporeal atoms, or a collision thereof as in combustion or other occasion of chemical action; but light, as the congener of heat, is motion of a substance some of whose properties are distinct from those of Matter. Light consists of waves, those of a uniquely-tenuous, elastic and perfectly frictionless body excited by interaction with matter, the ultimate components of which are, for this and other reasons, presumed to be of like basic consistence.

Certain negative properties of the Ether are cognizable *prima facie;* as its invisibility and its intangibility, as well as its impenetrability and incompressibility by virtue of its superlative relation to all other functionaries of physical force in Nature. Its positive attributes are deducible from the observed and explicated phenomena of light, the most significant of which are the swiftness of its propagation, the immensity of its radiative range, and its instrumentality of vision. The rays of light cannot reach beyond the confines of its medium; and inasmuch as vision is a cosmopolitan endowment of sentient beings, the range of light as its implement must be cosmical; so that, though the galaxy may outreach even the prospective ken of optical instruments, the Ether, as the medium of light, must embrace the whole world of stars. It also permeates all porous bodies, insinuates between the atomic constituents of particles, and "extends, without solution of continuity, through the humors of the eye." The Ether's claim to the epithet *pericosmic* is thus established; but whether it be finite or infinite in spacial extent is determined by inference from other data. The presumption that "it fills space," though confidently uttered by several notable scientists, is, nevertheless, unscientific. As the medium of light, the Ether outreaches the scope of optical research—the broadest of all modes of observation—the precincts of whose sphere are indefinitely conceived. For this reason only, the volume of Ether is immense, and the bulk even of its material contents is invisible; but its finitude is certified by the truism that a concentric force must have a center, which is impossible without a circumference; and neither this nor that is predicable of infinite space.

The propagation of light is analogous to that of sound: both are undulatory. As sound travels in waves of air, so light travels in waves of ether. "To account for the enormous velocity of propagation in the case of light," writes Dr. Tyndall, "the substance which transmits it is assumed to be of both extreme elasticity and extreme tenuity." For "the greater the elasticity (of the medium either of light or sound) the greater is the velocity, and the less the density the greater is the velocity." Inasmuch as the velocity of light exceeds that of sound, by so much must the elasticity of the Ether exceed that of the earth's atmosphere. In other words, since elasticity is a predicament of physical force of which light and heat are phenomenal phases, the Ether's elasticity connotes a quantum of compressure transcending that of the earth's atmosphere as much as the speed of light transcends that of sound.

But the velocity of light's propagation depends upon another characteristic of the Ether of which too little account has been made hitherto, because, apparently, few scientists have even surmised its reality. This is its extremely flexile solidity, wherein it differs structurally from Matter, in any of the latter's overt forms. The common notion of solidity is coincident with that of *hardness*, which must be divorced from the concept as pertaining to the Ether, which is *solid* only in the sense of irrefragable continuity of body. It is literally solid in the same sense that nonimpressible substances are näively conceived to be, when regarded with no apprehension of their molecular structure. Whereas rigid particles are *not* solid according to vulgar appearance, the Ether *is* solid in this very ordinary acceptation of the word.

This attribute of the Ether is wholly due to its monatomic consistence. Were it polyatomic it would be a species of Matter, as Dr. Grove regards it, and most scientists presume it to be. But I am fully persuaded in my own mind that the Ether as a whole is an atom — *an indivisible unit of concentric force* differing not at all in essence and almost only in magnitude from the ultimate constituents of any tangible body. Were it material; that is to say, did it consist of aggregated atoms, these, by their mutual reaction, would obstruct the passage of light in proportion to their size and closeness of connection, just as sound is impeded by the jostling molecules of air. There is reason to presume that sound, as well as light, is germane to waves of ether, and that these are rendered bulky and so retarded by the atmosphere's reacting components. These are excluded from the wire of a telephone, the atoms of which are compacted to a solidity resembling the Ether. Is there any other reason for the greater swiftness of sound when propagated through a metalic medium? The velocity of light must depend as much on the structure of the Ether—its undivided and indivisible corporeity—as on its elasticity and tenuity. Its luminiferous function requires not only that it should be perfectly impressible as well as indued with reactive energy, but also that a breach of its unity or disparagement of its dynamic integrity should be impossible. Its elasticity, however, as indicated by the speed of light, is the proper index to the Ether's dynamic principle, which is thus found to be supremely potent. Since a body's capacity to undulate depends upon its elasticity whose co-efficient is compressure, and since the velocity of undulation depends upon both the range of a body's motility and the stress of its re-action when acted upon, the velocity of its undulation betrays its attribute of compressure as well as its elasticity. Therefore, the velocity of sound is proportional to the pressure of the atmosphere, and so the velocity of light must be proportional to the Ether's compressure; and the ratio of the square of the velocity of sound to the square of the velocity of light is equal to the ratio of the pressure of the atmosphere to the compressure of the Ether. Then of course conversely, as is the square of the velocity of sound to the square of the velocity of light, so is the pressure of the atmosphere to the Ether's compressure, which, according to this statement, is not less than six thousand million tons on a square inch. In the estimate of Sir John Herschel, it is a fourth greater. He answered this question expressly as a topic of one of his *Familiar Lectures on Scientific Subjects*, published in London in 1866, from which I have copied the following paragraph, beginning on page 281.

"Starting with the observed facts, that sound travels in air at the rate of 1090 feet per second, while light is propagated through the ether 186,000 miles in the same time (that is to say, 901,000 times as fast), we are enabled to say how many fold the elastic force of the air, or its resistance to compression, would require to be increased in proportion *to the inertia of its molecules*, to give rise to an equally rapid transmission of a wave through it. For it results from the theory of sound that in media of different elasticities (so understood), but similarly constituted in other respects, these forces are to each other as the squares of the velocities with which the waves travel: so that the elastic force of the air would require to be increased in the proportion of the square of 301000 (*i. e.* 811,801 millions) to 1, to produce an equal velocity. Even this enormous number must be still further increased, since the velocity of sound is augmented by a peculiarity in the constitution of air which we should hardly be justified in attributing to the luminiferous ether, in virtue of which its elasticity is increased by heat given out in the act of its compression, and without which the velocity of sound would be only 916 feet per second instead of 1090.

Thus the number above arrived at has to be further increased in the proportion of the square of 1090 to that of 916, which brings it to 1,148,000,000,000. Let us suppose now that an amount of our ethereal medium equal *in quantity of matter* to that which is contained in a cubic inch of air (which weighs about one-third of a grain) were enclosed in a cube of an inch in the side. *The bursting power* of air so enclosed we know to be 15 lbs. on each side of the cube. That of the imprisoned ether then would be 15 times the above immense number (or upwards of 17 billions) of pounds. Do what we will—adopt what hypothesis we please—there is no escape, in dealing with the phenomena of light, from these gigantic numbers; or from the conception of *enormous physical force in perpetual exertion at every point through all the immensity of space.*"

The reader will observe that what Herschel called "billions," we on this side of the Atlantic call trillions. Fifteen times the previous "immense number" is 17,220,000,000,000 pounds, or 8,610 million tons. Make this number of tons the conceptive multiplier of the imagined number of square inches embraced by the pericosm, and fancy the unwritable symbol of pericosmic energy. It is stupendous, yet finite. It does not measure creative power, nor is it cognizable as the forte of mundane nature's Author, whereof the world of vegetal and animal life is more suggestive. As a datum of purely physical science, however, it is logically available to supersensible intelligence. Since the Ether is pericosmic and holds the *ensemble* of Matter within its mighty grasp, its control thereof must be dominant. No other power than the Creator of both can wrest this from that. Gravity is manifestly due to an extraneous force, else it would not vary with a body's change of place; and since Matter is passive and the Ether active (correlatively), this containing that, why should not Matter gravitate in effect of the Ether's pressure?

It is obvious that diffuse matter subject to no other force than pressure by the substance of its vehicle would be thereby consolidated. This would be a species of gravitation, but not of the cosmoplastic genus which generates suns and planets. As a volume of concentric force, the Ether must have been aboriginally spherical. Therefore its compressure, unless modified by some partially-counteractive force, would be greatest in its periphery and least at its center, toward which all its material contents would be pushed by its exclusively-concentric trend. Such an event must have forestalled cosmic evolution, whose issues in the formation and perpetual promotion of the extant stellar system evinces that what appears to be the work of universal gravitation has not ensued from the Ether's pressure alone, yet without lessening the probability that it has ensued from this in conjunction with some diverse but ancillary force. And the conception of what this co-agent of cosmic evolution may be, without which gravity would be abortive, is not far-fetched. It is discovered without seeking beyond the rationale of certain astronomic indications that the universe turns on its axis.

Regarding the Ether as a sphere of concentric force, its ascertained stringency is surely adequate to all the phenomena of centripetal motion in the world of Matter; and why may not all the phenomena of centrifugal motion be due to the rotation of Matter's vehicle? The latter trend of motion is as indispensible to cosmic evolution as the former. The twain must, therefore, have been co-etaneous and co-active from the beginning. It is impossible that either should have given birth to its virtual colleague. It is certain that a sphere of concentric force would become the vehicle of an equivalent excentric force by being made to rotate with condign velocity; and no other method of generating the latter and co-ordinating the two is conceivably feasible. Moreover, that the pericosm does actually rotate there is very taking evidence apart from this apparent *sine qua non* of its agency.

There are three items of astronomic science which appear to be incidental to the rotation of the whole physical world. One of these is the visible shape of the Galaxy. Astronomers call it lentiform. Sir William Herschel, reasoning from optical data, compared its form to that of a millstone. Other scrutinizers of the nightly face of Nature, conceive it to be ring-shaped. To ordinary open vision, as well as to reflective reason, it is a stellar zone or belt of stars, representing *a great circle* in the technical acception of this phrase; and it is commonly styled the Galactic Circle. But no astronomic writer that I know of has divulged a thought of *why* the stellar system has assumed such a conformation; nor is there any assignable reason for this issue of cosmic evolution so long as the rationale of gravity is ignored. But let the luminiferous Ether be recognized as the *nidus* of cosmic motivity, whose dual manifestation in Nature is due, first, to the Ether's *pressure*, causing the gravitation of matter, then, to the integral *rotation* of the Ether's volume, causing a centrifugation of its own substance as well as of its material contents, and thus the contour of the visible universe as identified with the Galactic Circle is rationally accounted for.

Another indication that the physical world turns on its axis is the fact that all the planets move faster and are nearer the Sun in one part of their respective orbits than in the opposite part. The only explication of this fact to be found in books on astronomy is the supposition that the planetary orbits are elliptical. But if this hypothesis be true, which is doubtful, the question then occurs, Why are they elliptical? It has been generally presumed that they ought to be perfect circles, if the two factors of orbital motion are equipollent, as otherwise they appear to be. It is more likely, therefore, that the orbital motion of planets varies in velocity for quite another reason than the shape of their orbits, namely, in effect of the rotation of their common vehicle, the pericosm, whose axis is perpendicular to the plane of the ecliptic or mean plane of planetary motion, which is evidently coincident with the plane of the Galactic Circle; so that, one part of each planetary orbit being nearer to the axis of the pericosm than the opposite part by the whole diameter thereof, the vehicular motion of each planet is alternately increased and decreased: this differential vehicular motion being at one time, that is in the outmost quadrant of the orbit, added to, and at another time, that is in the inmost quadrant of the orbit, subtracted from, the orbital motion of each planet. This being the only conceivable explication of a well-known astronomic phenomenon, it validates the inference that the vehicle of Matter does verily rotate.

This inference is also confirmed by an ulterior principle of cosmology. It is scientifically conceived that planetary motion obtains upon nebular rotation; but how nebular rotation originates is still a question among cosmologists. Mr. Herbert Spencer many years ago imputed its generation to the coincidence of gravitation and chemical action. His argument to this effect is the least-efficient part of his essay on "*The Nebular Hypothesis*," which as a whole, is not inferior to any of his notable "*Illustrations of Universal Progress.*" But his lucubration on the topic of this paragraph, though significant of ingenious research, is not convincing. Its most essential factor is the postulate of a resisting medium identified with the rarer portion of a nebula. But such a medium is fabulous, because, being hypothetically material, its substance must be subject to the same laws of gravity as the denser parts of an evolving nebula, and therefore these could not be effectively resisted by that. But the question is not amenable to the logic of speculation; nor can we find its answer by experiment. Science can answer it mathematically, and perhaps not otherwise. I think it demonstrable that the rotation of a nebula cannot ensue from the gravitation of its substance, even with the help of chemical action, while it must ensue from the Ether's pressure coincidently with its integral rotation.

NOTE.—I have coined the word *pericosm* to designate the Ether *in toto* as the vehicle of Matter, not to replace nor restrict the meaning of the word *ether*, which by conventional usage has never signified more than the appellation of a substance whose *positus* is pericosmic. For the word *cosmos*, in symbolizing the broadest concept of the physical world, has hitherto included only the material range of Nature, the reach of Matter, which, as now conceived and described above, is completely enveloped by the dynamic agent of its subordinate functions.

CHAPTER III.

PHYSICAL FORCE—THE PITH OF BODY AND THE FORMATIVE FUNCTIONARY OF COSMIC EVOLUTION.

To ordinary observers, all the physical phenomena of the visible world seem to ensue from the translocation of bodies and transformation of Matter by an unseen motive power vaguely designated Force. This mysterious agent has never been confounded with Matter; though in its transitional aspects it is commonly supposed to have no existence apart from some imbodiment; wherein, however, its stay is precarious because of its liability to sudden and rapid transmission from particle to particle in case of their collision. What is its mode of continuance in the interims of its successive translations seems hardly to have been thought of. It may be imagined that there is no interim in the case, because of the contiguity of colliding particles, without which Force is always detained by the isolation of its *nidus*. This assumption is virtually true, and it is important to note its logical sequel, namely, that the insulation of particles by the intervening ether connotes *its* structural difference from Matter. Nor is this relevant induction overlaid or in any sense disparaged by the coincident conception that the riddle of *force in transitu* is solved and its mystery dissipated, if not evaded, by the prior conception that *motoric force is not an entity*, but a sheer phase of motion. Now, motion is a universal fact. Though to sensible appearance many forms of Matter are relatively stationary, it is certain that the material world is a mechanism of perpetual motion, many parts of which are also constantly moving in diverse ways. This is in a manner predicable even of the minute constituents of Matter, every species of which is differentially motile; yet with no implication of material motivity. It is only certain modes of motion that are inherent to matter, other modes being adventitious to it; and one particle cannot move another, however it seems to, as it may only for want of knowing in what the cause of motion consists. Force, as a producer of motion, must have a *nidus* distinct from Matter. Those scientists who (as Helmholtz) talk of the material part of the physical world as the proper store-house of motific force, have not explained *how* the inert portion of the Cosmos could be fraught with the agent of its own impulsion. One might as well talk of the mechanism of a cotton-mill being *stored* with the force by which it is operated. In Nature, as well as in Art, the impelling power is always extraneous to the thing impelled.

The pertinent truth discoverable by adequate research is, that the whole process of cosmic evolution is due to the juxtaposition of two distinct substantive entities, namely, *Matter and the Ether*. The character and consistence of the "pericosmic Ether" have been partially discussed in the preceding chapter, wherein the conclusion was reached that the medium of light is an atom of concentric force. This is as much as to say that Force itself, as the essential stuff of the pericosm is substantial. Instead of revolting from this issue of inquiry, let us assent to the survening insight of two categories of physical Force, and for sake of distinctive contemplation, let us call the one *motoric* or *motific* and the other *static*, this being the fulcrum of that. To say *how*, is in order and not to be long deferred; but a more explicit theory of Matter, of the relative nature of its properties and functions, than has been divulged hitherto, is preliminary to that as well as relevant to the general import of this paragraph, and may be requisite to its appreciation by the reader.

It has been said by representatives of popular science that Matter is known and knowable only as the sum of its properties. "What we know as Matter," writes Mr. John Fiske, "is a series of phenomenal manifestations." But this is not the whole truth. What we know as Matter is the sum of its alleged properties together with the conception of their existence as depending on an occult *nucleus* without which none of them can subsist. This *nucleus* is the substratum, not of Matter *in re*, but of its properties; the *word* matter being the symbol for what we *seem to know* of Matter and what we *surmise* as to the unknown complement of our phenomenal intelligence thereof. The notion of substance without attributes is absurd; and so is the notion of attributes without a substantial entity. Thus we are rationally impelled either to postulate a corporeal base of Matter's properties or else to ascribe their colligation to the immediate agency of creative power. To do this were to abandon science and don the sacred veil of mystery.

The truth is, what is called "the substratum of Matter" is no more mysterious and apparently inexplicable than are some of its alleged properties, as for instance gravity, when we begin to theorize as to their consistence or seek their rationale. The phrase should stand for that part of the nature of Matter which eludes sensuous perception, yet is quasi-conceivable as the latent *pith of body*; *this* phrase, in so far as it is philosophically significant, denoting *that which virtually supports existence*—the mundane proxy of what the author of *the Synthetic Philosophy* has denominated "the unknowable." But I shall call it *Force, the physical offspring of the Infinite Mind.*

The vulgar notion of Matter is crude, but not wholly fallacious; though involving a mystery, it is largely truthful. It compasses more than a synthesis of properties; for when we think of these singly as unsubstantial, we fail to conceive of their union without an imbodiment, which itself is inseparable from the self-same properties. Hence the nut of a mystery whose shell is ignorance and whose meat is conjecture. The mental predicament which gives birth to this mystery is incidental to human development, and as natural as any older mystery now dissipated, like for instance that of the diurnal revolution of the Sun, Moon and Stars, until Copernicus exhumed the buried lore of twenty by-gone centuries and with the hammer of Pythagoras cracked the nut of Ptolemy's misconceit. So the pith and constitution of Matter are but nominal arcana of Nature which the growing indagation of Wisdom's votaries is bound to penetrate. It has been already ascertained that Matter consists of atoms so minute as to elude the ken of miscroscopic vision. Yet their size and weight are chemically determinate, and probably their diverse shapes also are susceptible of rational discovery*: and if these depend upon their inherent rotation with differential velocity, which is more than probable (especially of the organo-genetic atoms), we may thence infer the metamorphal principle of their chemical aptitudes.

The fact that atoms of any given element of Matter cohere without change or compromise of their specific nature suggests the dependence of chemical action on the correlative shapes of atoms, or their mutual adaptation like tenon and mortise; and the merging of elemental characteristics in the properties of compounds denotes atomic changes of shape in the formation and dissolution of molecules. This implies a metamorphic susceptibility of atoms such as can consist only with their extremely elastic pith

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*"It is the conviction of almost every physicist of the present day, that the next great step taken will be to show what is the constitution of a molecule; what is the shape of it; and how the parts of it act upon one another."—Prof. Clifford in *Seeing and Thinking.*

like that of the Ether. Yet the fact that the polyatomic elements of Matter undergo no change of attributes by repeated agglomeration as well as by composition and decomposition in the works of Nature, demonstrates the essential immutability of atoms. They are subject to no wear nor waste. They must be durable beyond what may be affirmed of any material thing of human observation. Diamond may be crushed and time will crumble adamant. The atoms of which Matter consists must be made of other stuff than what we know as the various products of their composition. What is it?—if not *concentric force, the same in essence as the luminiferous Æther.* The late Prof. Clifford, ten or twelve years ago, broached the opinion that the ultimate constituents of Matter are "made of the same stuff" as the pericosmic atom, in view of the fact "that they obey the same laws, and that they act upon one another in accordance with these laws." Concentric force is the probable pith of all substance, and no other substratum of Matter appears to be conceivable.

To make this answer satisfactory we only want to know more clearly what Force itself is. We have grown familiar with the term, yet with but a vague notion of the thing denoted by it, because of its long application to heterogeneous phenomena, with no better definition of the word than "that which produces or resists motion," as Dr. Grove defines it; or than that given by Dr. Faraday, "the cause of a physical action," which, though not more explicit, is, I think, more profoundly suggestive.

Either of these definitions is good for more than the verbal drift of its terms. To explicate the dual import of the former is to generate an idea of physical Force as practical as Science has as yet evolved concerning Matter. Grove's definition implies two functions of Force, or else two agents, the one of motion and the other of persistent station. For that which *produces* motion cannot be identified with that which *resists* motion in the same sense and in the same categoric predicament of things; though in different senses the two may be coincident in one and the same body. In the bending of an elastic bow, for example, one and the same motion is coincidently produced and resisted, but by opposing agencies; and when the bending force relaxes, the resisting force prevails and the motion is reversed. If an atom is indivisible it must be because its substance coheres beyond any extraneous power to divide it. Its persistence is conceivable as concentric force. This, I repeat, is the pith of body, the real substratum both of Matter and of the Ether. But its better name is *static force*, since concentric force is sometimes coincident with motion, as in the evolution of a planetary system by condensation of nebulous matter in effect of gravity. Gravitation is essentially *motoric* and due to an ulterior mode of Force which, though *actually motific* is *essentially static.* Thus Nature exemplifies two universal predicaments of Physical Force, which, as the primordial and coëtaneous means of cosmic evolution, are mutually dependent, being operative only in concert. Yet Static Force is the substantial base of Motoric Force, and Motific Force is nothing but — the *virtual* cause of motion — the embrace of Matter by the Ether.

The apparent cause of motion is called *motific force*. It may be either motoric or static *per se*, or consecutively both, and either natural or connatural, but always adventitious to the thing which it moves; as a mill-stream and a mill, a hand and a windlass, or a generater of steam with its constrictive and motive apparatus. That which moves all the machinery of the physical world is the rotating pericosm. This, however, is only the instrument of *primum mobile* in the process of natural causation.

Motoric Force is that which is inherent to its own vehicle. It is either aboriginal, as in the rotation of atoms, in which case it is the immediate product of creative power, or induced by some implement of natural causation; as is gravitation, which ensues from the pressure of the pericosmic ether; as is also planetary motion, which is the outcome of nebular rotation induced by the primordial rotation of the pericosm as gravity's compeer to the finale of mundane existence.

Static Force is that which persists without motion; as gravity, the cohesion of atoms, or that of which atoms consist. Static Force, as the pith of substance, ethereal and material, is the vehicle of motoric force, whose sensible phase is motion. In view of this relation, Static Force may be regarded as the pedestal of physical existence. Gravity is an adventitious form of static force due to the immersion of Matter in the

Ether, like that of a solid body in a liquid. Specific gravity is a genus of static forces whose species depend upon diversity in the molecular structure of material particles. Thus atoms represent the pristine form of static force, while their rotation represents the pristine form of motoric force. Other forms of motoric force are germane to the inherent elasticity of atoms which by collision and otherwise give birth to three adventitious modes of motion, namely, the oscillatory, the undulatory, and the translatory. These three phases of motion are differentially combined in the vibrations of a pendulum and in those of an agitated chord.

There are two universal predicaments of Static Force as exemplified in the diverse constitution and harmonious marriage of the Ether and Matter, with whose co-operative functions as disparate yet conjoint entities the whole process of cosmic evolution consists. Germane to this relation, there are two universal modes of motion, the one ensuing from the pressure of the Ether on its material contents, and the other from the rotation of its volume. Out of these two attributes of the pericosm spring all the mechanic and chemic powers of Nature, whereof Matter is the fulcrum and the Ether the lever, this being swayed and even that upheld by the Supernatural Agent of natural causation.

The versatility of force as the operative instrument of natural causation depends partly on the nature of Matter and partly on the ternary modality of its formation, three species of which are primordial, giving birth to three apparent properties of Matter —*gravity*, *volatility*, and *mutability*. Gravity is germane to the Ether's pressure; the volatility of Matter is germane to the Ether's rotation in volume; and the mutability of Matter in its overt forms is due to the inherent differential rotation of certain elementary atoms, whose equal elasticity is contingently promotive of diversity in the physical processes of mundane existence, the prime issues of which are *heat*, *light*, and *electricity*, as incentives and aids to *chemical action*, *vegetation*, and *animation*.

Everybody has heard of the indestructibility of Matter and of the unmitigable persistence of Force. The axiomatic drift of these phrases is not rigidly literal. *Static Force*, as the pith of body and base of motion, persists unchanged coëtaneously with physical existence. *Motoric Force*, as identified with the rotation of organo-genetic atoms, though apparently modified by chemical union of its diverse vehicles, is virtually absolute and undeviatingly persistent. *Motific Force*, as identified with the pressure and rotation of the pericosmic Ether, is indigenous, perpetual and unvarying; but all other modes of motion traductive therefrom are pivoted by adventitious revulsions of motility, material and ethereal, whose phenomenal issues are transitional and variable.

Nota bene, it is the substratum of Matter, or rather of Matter's properties, not "matter as we know it," that is imperishable and indestructible by other than creative power. Matter in all its phases due to the temporary combination of atoms, is both perishable and artificially destructible. But these apparitions of Matter *in re* are the proper ingredients of physical existence — the eclectic means of natural causation: for Existence is a *process*, not a stable world of statuesque verities. Nor is Motoric Force a unit of mechanical power, whether conceived as an efficient of motion or motion in abeyance. It is rather a current — a perpetual drift, in similitude of a water-power or steam-power; though its reservoir is an abiding dynam of unswerving potency. But the function of this reservoir is mediative, like that of most aquatic reservoirs, whose capacity as a receptacle of motive power is relevant to its utility as a motor whereof the influx just equals the efflux. For since the pericosm is not lessened, either in bulk or in compressure, as may be inferred from the changeless weight of any material at the Earth's surface, its store of Force must be a constant quantity. But how can this be, unless that which Matter receives therefrom and transmits we know not whither in the forms of light and heat, never to be re-assimilated dynamically by the Ether, is replaced by an equivalent influx from the eternal source of all power?

CHAPTER IV.

DYNAMICS OF GRAVITY, MOMENTUM, AND CHEMICAL ACTION.

It is maintained in the foregoing chapters of this essay that the luminiferous Ether is in essence and contour *an atom — an indivisible unit of concentric force.* It has been intimated furthermore that the world of physical phenomena must be the issue of two dissident, yet congenial, pericosmic forces, distinguishable as concentric and excentric, this being adventitious to that; that the coördinate functions of these two species of Force, as co-agents of cosmic evolution, requires that their co-existence should entail no compromise of their distinctive nature and prestige; that their coälition without assimilation is practical only with their separate dependence on a dissimilar impetus, which desideratum is cosmically attained by means of the Ether's rotation in volume; that it is only in the light of that whole view of the subject suggested by this condensed statement, especially that of its culminating point, that the Ether can be regarded as the physical agent of gravity. What is thus rendered ideally probable, may be confirmed to a logical certainty, by considering in descriptive detail the mode of gravity as effected by the said duality of its physical cause, and its accord with that of momentum and with that of chemical action, together with their triune rationale.

It is conceptively-evident that a single body contained within a sphere of exclusively-concentric force would be subject to equal antilateral pressure thereby only at the center of that sphere, and that if placed elsewhere therein the pressure on its sides would be unequal and least on the side nearest the center of its vehicle, toward which it would be pushed by the greater pressure on the side farthest from that center. If, however, the material body were placed at any point within the sphere of concentric force and this were made to rotate with a suitable velocity, just sufficient to generate an excentric force equivalent to the concentric, the contained body would remain stationary in relation to its vehicle. But now, suppose two bodies to be placed, not far apart, within the same sphere of concentric force now constricted by rotation of its volume: it is evident with reflection that their correlation begets a new condition of dynamic agency on the part of their common envelope. Each becomes subject to an unequal antilateral pressure in consequence of their collocation, whereby the intervening quantity of constricted force is diminished and virtually divided between them. The effect is obvious. Their obverted sides are in the line of least external pressure (the line of gravity), and thus they are passively impelled toward each other. And this is the mode of gravitation. Herein we see just how the medium of lumination acts also as the agent of gravity, both static and motoric, not by any change of function as to the cause of either, but by a sheer difference of correlation; light being generated by the consecutive action of the ether on matter and its re-action through matter on itself; the static gravity of a material body being due to the circumambient *parity* of its pressure by the ether, while gravitation or motoric gravity is caused by the collateral *disparity* of the ether's pressure on the individual components of any and every material body: which disparity, however, can never obtain otherwise than between two or more particles or atoms which are collocated within a certain distance from each other.

Why, then, are solid bodies heavy? Why, when unsupported, do they "fall" to the Earth's surface? and what makes boulders, pyramids and mountains stand firm in their local positions? It is all and only because the ether, the constricted force of the pericosm, presses relatively-downward on their respective summits (virtually) as much more vehemently than relatively-upward on their respective bases as would be indicated by their respective artificial weights. But if this alleged downward pressure pertain to the upper surface alone, why is it no greater on the double surface of two homologous bodies placed side by side than when one rests upon the other? The familiar fact here adverted to is the only one that seems to favor the notion of an inherent gist of gravity, since the weight of a terrestrial body is always proportioned, not to its bulk, but to its density.

But the implication is imaginary. The covert truth underlying appearance in this relation is, that the weight of a body depends immediately on *the bulk of ether which it displaces*, and this must be proportional to the quantity of matter of which a body consists, unbiased by the measure of its volume, because all forms of gross matter are more or less porous, that is effused with ether which can be displaced only by a substance antithetically equipollent with itself, as is every atom of Matter. So gravity is to be accounted for by conceiving that the ether contacts with the outer surface not only of every material body, but also with that of every atom of its structure; and furthermore, that the downward pressure thereof on the ultimate components of porous bodies exceeds its upward pressure to the same extent (proportionally) and for the same reason as is predicable of the masses which they compose. In this view, it becomes evident that gravity is not an inherent property of Matter, but the issue of Matter's embrace by the Ether, complemented by the collocation of particles.

Another function of the Ether is erroneously imputed to Matter, though only with a negative argument in its favor. It is the momentum of moving bodies. It is said that matter has power to take on and retain motoric force, insomuch that a body once put in motion will move onward forever unless stopt by some counter force, as a resisting medium or collision with another body. And this assumption is made upon no other base of reasoning than the assurance that Matter *has no power* to stop its own motion, and against the equal assurance that a moving body has no inherent power to prolong its motion. This negative attribute of Matter, its sheer inability to change its own state from rest to motion or the reverse, connotes no ability to hold fast either predicament. Whence, then, a body's manifest repugnance to a change of state, either static or motoric? It is due to the persistence of force; but what *is* force apart from its vehicle, and why does *it* persist? Can the vehicle or medium of motivity become motific? Where is the evidence that the thaumaturgus called force is self-sustaining? Every example of it within the range of human observation, both in Nature and in Art, consists with a continuous draught from an anterior resource. The locomotive stops when the steam is exhausted, and this lasts no longer than the relevant use of fire and water. This is of course partially due to the resistance of air and friction of machinery; but who knows that in the absence of all obstructive conditions, yet without an extraneous agency of propulsion, the motion of material bodies would be perpetual? Is it scientific to affirm that which Nature gives us no opportunity to test by experience? — unless the subject of affirmation be grounded upon some truism, in which case it must be indubitable. By this reflection the pseudo-axiom that would idealize inertia as a positive endowment of Matter is reduced to an open question. Inertia itself is explicable only as the counterpart of gravity. Neither this nor that can be inherent to Nature, since they coexist; and gravity being an adventitious force, so must be inertia. Their difference is almost nominal, or at most as kindred as *pressure* and *resistance*, the two most obtrusive attributes of the Ether in its relation to Matter.

The notion that physical force in any of its phenomenal phases is self-persistent is absurd. The axiom affirming its indestructibility is but relatively true. All that is scientifically apprehended hereabout is its dynamic constancy in all its transitions. It is rationally-certain that this seeming wizard of cosmic evolution is a unique product of natural causation in the primordial department of its process, which as a whole depends on the constant volition of its occult causal agent, that is creative power. Whatever is not of necessity may cease to be at the will of its producer, whose function is always voluntary though commonly mediate, or made effective through finite instruments; every insentient agent being but an implement of a sentient operator to some special purpose.

Scientifically considered, physical force is not an entity, but a phenomenon of action distinguishable from motion only as motivity, which implies an ulterior entity as its base superlative to Matter and similar in character and function to the pericosmic Ether. This, inferentially, is its proper *nidus* wherein it resides potentially, and whence it issues in the guise and equipage of motion, to be propagated from body to body, but never to return to its native habitat, save as a flying visitant on the wave-wings of light. Whether or not it ever tires of this flighty predicament, or, what is possible for ought we know, is wont to pass the bounds of the pericosm, deserting this world to illuminate the broader *terra-firma* of deathless mentality, is food for conjecture.

The pericosm is the agent of gravity, as shown above. Out of that, gravity and gravitation are impossible in the nature of Matter. If a particle of matter as we know it could exist without gravity, who knows that it could acquire momentum? If the Earth could be thrust out of the Ether and retain solidity in empty space, it may be that a human hand could move it, there being nothing to resist its motion; but it is not likely, there surely is no evidence, that it would continue to move after the hand which had pushed it should be withdrawn.

It has been queried whether or not the Ether is a resisting medium; and if it be, how its supposable tendency to retard the orbital motion of planets is to be reconciled with its apparent non-resistance. The answer to this question is discriminative. If the Ether offered no resistance to the motion of particles, it would be powerless to determine the order of planetary motion or to pertetuate its specific periods. The Ether's resistance to the motion of a body is coincident with its pressure thereon, and therefore necessary to its function as the agent of gravity. It is because of its fitness to resist the motion of its material contents that their gravitation varies according to their differences of collocation. In fact, the ether's resistance to a body's change of state from rest to motion is the very essence of its inertia, without which gravity would exist to no lasting purpose. The tether of every solar orb is the Ether's resistance to its translatory motion; but the orbital motion of every planet is perpetuated by the momentum of its nebular parent's rotary motion. Yet there is no friction between Matter and the Ether, this attribute of motion being due to the atomic structure of Matter, from which the Ether differs as an unbroken and indivisible substance whose most expressive appellation is *the pericosmic atom.*

If then the Ether is a resisting medium, why are not the planets impeded thereby, as they seem not to be. I have just said why, but will say again Because of the nature of momentum, which is born of the Ether's elasticity and measured by its resistance to the orbital motion of planets as entailing its relevant collapse behind them; this being a corollary from its agency in propagating light.

The Ether's pressure on the sides of a body at right angles to its gravity is antilaterally equal. To move a ponderous body when situated as the planets are, apart from material resistance, it is only requisite to overcome the balance of the ether's pressure. To do this perceptibly requires a motific impetus proportional to the weight of the body to be moved. The chief obstacles to the artificial movement of terrestrial bodies, or those on the surface of the Earth, are the resistance of the atmosphere and the friction cöincident with gravity and the structure of gross matter. Could these impediments be completely annulled or avoided, the movement of heavy bodies would be comparatively easy, and it is quite certain that in that case, a body once set in motion would not cease to move so long as the extant order of the physical world should continue. But wherefore? Not because of its inability to cease moving. A body once put in motion continues to move until it encounters some obstacle, *here*, *within the pericosm*, because of its momentum, as explained above. Outside the pericosm, which must be finite, a particle of matter would not move beyond the reach of a continuous impulsion. Nor does it now, anywhere in the physical world; for momentum, consisting as it does of the collapse of ether behind a moving body, is a perpetual renewal of the pericosmic impetus.

A writer in Chambers's Encyclopedia dealing with topic "Force" makes this remark: "We do no work, however much we may fatigue ourselves, if we try to lift a ton from the floor; if it be a hundred weight only, we may lift it a few feet, and then we shall have done work." What is the rationale of this truth? I have not found it in any book; but, according to my theory of gravity, the explication is germane to the kindred truth that (as the same writer says contextually) "momentum is the true dynamical measure of force," and momentum is extraneous to matter —or the *nidus* of momentum is extraneous to the body which seems to vehicle it, but is really moved by it. The reason why the force actually exerted in trying to lift a weight too ponderous for a man to move induces no momentum in the body acted on, is, that the ether as the proper *nidus* of momentum is not at all acted on until the weight is raised, or begins to move, when, disturbed by the body's motion, the ether collapses behind or below it; and that is the noumenon of momentum.

The fact that when the horizontal motion of a body is fairly instituted it continues with less extraneous impulsion than is required to start it, implies a *quasi*-self-persistence. The kindred fact that when a body is moving horizontally it requires the counter-application of considerable extraneous force to stop it—as much as is required to move it from a state of rest—seems to validate the inference that the motific impetus is virtually imperishable, and fails (apparently) to be perpetual only in consequence of the obstacles to its resultant noted above. By connecting the two facts here adverted to with the astronomic fact that the orbital motion of the planets is both perpetual and periodically unvarying, the dynamic equality of a moving body's momentum with its inchoate impetus in a line perpendicular to its gravity, is logically certified. And the reason for this equality is rather obtrusive. Both modes of motion are generated by one and the same dynamic agent. The momentum of a moving body is evolved by the ether's elasticity, by virtue of which it re-acts with a vehemence proportional to the speed of its agitation; while the impetus to the motion of matter is born of gravity, which is due to the ether's pressure. But inasmuch as these are cognate attributes of a single entity, the one exactly measures the other in respect of dynamic capacity; and upon this deductive principle of physical science the perpetuity of planetary motion is established, notwithstanding the Ether's unvarying local resistance to the translatory motion of its material contents.

The momentum of falling bodies, as differing from that of horizontal motion, has never been accounted for to the satisfaction of telesophic scientists, yet is perfectly explicable according to the principle here maintained. It has been imagined that falling bodies are hastened in their descent by their increscent weight. But this cannot be, since it is found by experiment that the weight of a body is not lessened perceptibly by being raised a hundred feet above the Earth's surface. Homologous bodies are probably lighter at the summit than at the base of a tall mountain, but to no sensible degree; and though this fact is partly ascribable to their greater buoyancy by the atmosphere below than above the sea-level, yet with due allowance for this compromise of gravity, the difference of weight in the two cases is vastly inferior to the augmenting *vis viva* of a body falling even from a comparatively low altitude. Therefore this is not imputable to the slow and petty increase of weight which is thus attainable. It is due to the *agent* of gravity, though wrought out by another attribute thereof than that whence gravity springs. The silent partner of the ether's pressure in this function subordinate to the vocation of gravity is the ether's extreme elasticity, provoking re-action, as said above. The collapse of ether above a falling body is incrementive, not because of the latter's increasing gravity which is imperceptible, but because of the continuously-accelerated velocity of its fall, which is redoubled, together with the momentum thereof, every successive instant of its descent. More explicitly, the collapse of ether behind a moving body is more or less rapid and forcible according to the quickness of its displacement thereby; and this depends on the velocity of the body's motion, which itself is determined by the quantity of its impetus. In horizontal motion by a given impetus, the velocity being steady, the momentum is also equable. And the virtual cause of both this and that is the prior fact that the pressure of ether before and behind the moving body was equal at the start, and continues unrelaxed. But in the case of a falling body the ether's pressure is greater behind it than before it—its downward-pressure exceeds its upward-pressure by the whole weight of the falling body. And to this difference of antilateral pressure (the unvarying weight of the body) is continuously added the augmenting vehemence of the ether's collapse, in accord with the increasing velocity of the body's fall.

There are two other special functions of the Ether which deserve notice in this discursive exposition of its dynamic agency, one of which, however, is but a phase of gravity. This used to be called "cohesive attraction." There is such a thing as cohesion, though not imputable to an inherent property of Matter. The cohesion of atoms as exemplified in all solid bodies, and to some extent in liquids, is due to the pressure of ether, whereby atoms in close proximity are compacted so firmly as to become inseparable without violence to their conjunctive form.

A more abstruse function of the Ether has been also misnamed "chemical affinity," both which appellations have recently become obsolete and aptly replaced by its scientific designation, *chemical action.* This term is expressive merely of the phenomenal aspect of that mysterious agency whereby the elements of Matter are diversely compounded and recompounded to the development of all the multifarious substances which, by their distinctive qualities, serve as means to the utile ends of mundane existence. Chemical action outside the pericosm is impossible, and so it would be inside without a certain complex and positive attribute of Matter itself, which is not altogether inert and passive, but, in respect to this last-named function, is the Ether's coagent and compeer.

There are legitimate and cogent reasons for believing, and only illegitimate reasons for doubting, that Matter is composed of infinitesimal globules of concentric force, each of which in its pristine state was analogous to the pericosmic atom. These ultimate constituents of matter in its tangible forms are relatively static or motoric, according to their collocation as contents of the pericosm, which, though apparently promiscuous, are not lawless, but, by virtue of the differential make and homogeneous pith of atoms, apposite to the mediate aims and uses of natural causation. The ultimate constituents of matter, being made of one and the same kind of stuff, are equally elastic, and differ only in size, shape, and metamorphic susceptibility; their mutable forms depending on their inherent rotation with different gauges of velocity. Those which do not rotate are of course spherical, while the axis of rotation in those which do rotate is more or less shortened or dispelled to vacuity thereby, giving birth to spheroid, discoid, and even ring-shaped atoms. These miscellaneous units of concentric force exist in myriads, and when classified according to their respective size and shape, those of each class are also innumerable, that is to finite mentality; the exclusive aggregation of homogeneous atoms being what is known as an *element* of Matter, the diverse phases of which are classified as solids, liquids, and gases. The atomic components of certain solids; as iron, copper, lead, etc., though differing specifically in size, agree in being spherical, while those of certain liquids, as mercury and bromine, are probably spheroidal, and those of certain gases, hydrogen, oxygen and chlorine, are variously ring-shaped. But the atoms of which any given element is composed are incapable of combination *inter se*, being for similarity, and for no other reason, susceptible only of mutual cohesion, *alias* compression by the ether to lateral contact, in which relation they still conserve their disparate identity as individual nodules of static force.

And now I fancy the reader's intellective foresight has outreached the product of my pen, and that what I am about to say has been already inferred from the last part of the preceeding paragraph. For the fact that atoms of the same size and shape are incapable of chemical union signifies that chemical action depends somehow on their different shapes; and the gist of composition appears to be their mutual adaptation in form. To obtain a vivid conception of this counterpart structure of combinable atoms, which is the base or fulcrum of chemical action whose lever is the Ether, it will suffice to think of an atom of oxygen as a revolving ring whose aperture is broad enough to admit an atom of carbon which is spheroidal, and to imagine the two brought together, when the less is forced into the greater by the ether's pressure in virtue of their coincident proximity. When the carbon atom enters the chasm of the oxygen atom, the contacting rim of the spheroid is suddenly relieved from the ether's pressure, while its hemispheric surfaces remain compressed; and in effect of these two changes in its relation to the pericosmic force, it expands peripherally in proportion as its axial diameter is diminished. At the same time and for the same reason, the inner rim of the atomic ring, is slightly depressed to contact with the outer rim of the latter, the dual effect of which is that the rotation of the oxygen atom is lessened and that of the carbon atom quickened, so that the twain body rotates as a unit. Thus is born a molecule of carbonic oxide, which typifies the modality of chemical action in general. This is not predicable of Matter alone nor of the Ether alone; it is an outcome of their correlation. Doubtless the aptitudes of Matter have been under-estimated in the name of inertia; but a thousand times more fallacious is the notion that one particle of matter can move another without a medium of contact, intrinsically different from Matter. Some extraneous force is requisite to the interaction of Matter's components, and even those of the atmosphere, elastic and motoric as they are *per se* and as is their fluctuating compound, would be motionless forever (otherwise than on their stable axes), without the Ether's pressure. On Matter's subjection to that depends every adventitious mode of motion, not only light, heat, electricity and chemical action, but sound, as well as the physical side of vegetation and even of animation, including every species of sensation, as hearing, seeing and objective feeling. The part which Matter plays as the Ether's colleague is active as well as passive, by virtue of the inherent rotation of certain atoms. But these might rotate forever in isolation without generating a phenomenon relevant to natural causation. So might the pericosm. Like a water-power without machinery, its dynamic capacity must be forever useless without the subordinate presence of Matter. As co-agents of cosmic evolution, they are co-ordinate, since all their functions are commutual. With a translated figure of speech, the Ether and Matter are to each other as the two pillars of an arch whose keystone is the shoulder of Atlas.

CHAPTER V.

GENESIS OF NEBULAR ROTATION.

The theory of cosmic evolution consists with the postulate that every solar and planetary system is the offspring of a rotating nebula; but how the rotation of this progenitor of planetary motion originated, is an ulterior question which astronomers have rarely attempted to answer. It is the object of the present writing to discover the rational evidence that nebular rotation ensues from the aboriginal rotation of the *pericosm*, by which appellation I would designate the ethereal vehicle of the whole world of Matter.

As to the origin of nebulæ, nothing is explicitly known as yet, nor seems to be knowable, except by inference from certain data of telescopic vision. That they represent collections of matter formerly so diffuse as to be telescopically invisible, is certain; but whether they first existed as distinct bodies, or their substance was primarily merged in the single *ensemble* of separate atoms with which the pericosm may have been impleted, who has said? No astronomer who has looked toward the beginning of mundane evolution has seen anything of the process of nebular formation prior to their discrete existence; and the telescope affords no other clue to their older history than what is implied by their hue and shape. These are various, and the latter is said to be generally irregular, but in some instances spiral, roundish or ring-shaped, with symptoms of metamorphosis; which characteristics indicate diverse modes of concentric motion — issues of conspiring forces to which their conformation is imputable. This refutes the supposition of their primeval existence as distinct bodies; and the conception of a composite fitness of the implied forces to aggregate and agglomerate nebulous matter in a manner essential to the formation of nebulæ, though by a process too remote rather than too slow for visual perception, is not too recondite for deductive exposition.

It is certain that the aboriginal form of the pericosm was that of a perfect sphere, and that, before it was caused to rotate, it was impleted with Matter the atoms of which were widely dispersed. If then the extraneous impetus to its rotation was temporally delayed, as it may have been, compressure of its material contents must have induced the incipient movement of Matter from the periphery toward the centre of its vehicle, making gravity the primal agent of cosmic evolution. The Ether and Matter being thus conjoined as the dual physical means of natural causation, it is not difficult to imagine the mechanical effect of the subsequent rotation of their biune volume. Its globular form must at once have become oblate and gradually discoidal, its axis of rotation shortening in proportion to the continuous expansion of its equatorial periphery, thus inducing in the nebulous contents of the pericosm two oppo site trends of spiral motion, one from each pole winding the axis anent the equatorial plane of rotation, where these two hemispheric motions must have met and thence rebounded, making of the whole nebula a countervailing couple of spiro-vortical rings. But these were predetermined to metamorphosis by the diverse trends of the Ether's integrant pressure, whose multifarious conflict with the spiral and vortical currents initiated a diuternal series of seggregations therefrom, primally and mainly from their contiguous surfaces. The process of nebular formation thus crudely outlined is still extant in the inner parts and polar regions of the pericosm, where, because of its inferior motivity therein, its function for seggregating and aggregating diffuse matter is more tardily performed. But this paragraph is more suggestive than expositive as to the modality of its abstruse topic.

Happily, the intended issue of the present discussion does not hinge upon any speculation concerning the origin of nebulæ. Mr. Herbert Spencer, in his classic essay on *the Nebular Hypothesis*, says nothing about the formation of nebulæ, but makes their existence in visible form the base of his reasoning in these words: "Given a rare and widely-diffused mass of nebulous matter, having a diameter, say as great as the distance from the Sun to Sirius, what are the successive changes that will take place in it?" The question admits of another answer than that which Mr. Spencer has propounded, though embracing comprehensively the same principles of natural causation as he adduces. The concentric energy of the pericosm being the physical cause of gravity as heretofore maintained, were its volume non-rotating, the designated nebula could never be formed, but all primitively-diffuse matter must gravitate to the center of its receptacle and there rest, condensing in time to a degree inconceivably harder than adamant, thus to remain, still, cold, dark and dead, a prodigy of useless existence. *Then*, if the pericosm, in that predicament of its solid contents, should be made to rotate, it would be with no tendency to evolve the nebular antecedents of solar and planetary systems. But, for this sequential work of Nature, given the rotating pericosm, as *nidus* of the two cardinal factors of cosmic evolution, namely, the *gravitation* and the *vehicular motion* of all matter, neither of which attributes thereof is conceivably existent apart from that, and both the genesis of nebular rotation and the formation of nebulæ must of course ensue therefrom. And this aspect of the question to be answered in this chapter is promising. For, since the gravitation of matter without its vehicular motion would have been worse than abortive, and since its vehicular motion without gravity is impossible, it follows by inference from the success of Nature's mundane projects that the two alleged universal modes of physical force are coëtaneous and must have co-operated from the beginning of cosmic evolution. Therefore the conclusion is inevitable, that the genesis of nebular rotation was inchoate and contemporaneously progressive with the aggregation of nebulous matter before as well as after its conglobation to constitute a nebula proper. Nevertheless, it may be expedient to suppress this truth at first, leaving it to come to light, as it surely will, by considering how nebular rotation would obtain if not initiated till a nebula was fully formed. To *say* how, is best attempted by means of diagramic illustrations, of which the first in order can be but inceptively relevant.

Diagram I represents the Solar Nebula as it was at the epoch of its spherical agglomeration when, as will be evinced in a subsequent chapter, it measured 10,263,675,733 miles in diameter and 32,244,363,683 miles in equatorial circumference, the radius of its equator measuring 5,131,837,866 miles. The letter X stands for the axis of the rotating pericosm, the lines diverging therefrom denoting sections of the latter's radiï. The section from X to G, though not absolutely immense, is practically immeasurable, as are also the arc *y z* and its analogues. But the distance from G to C measures the nebula's equatorial diameter. The line A E is equal and perpendicular to G C, and should be idealized as an elliptic plane bisecting the bulk of the nebula as well as its equator, and demarkating A C E as its outer from A G E as its inner hemisphere. The symbol Φ is the Greek initial of *pheretai*, signifying *it is carried* or *vehicled;* that is to say, the nebula is subject to vehicular motion, and Φ stands for that measure of it represented by the arc *y z*, which is virtually equal to either *rn* or

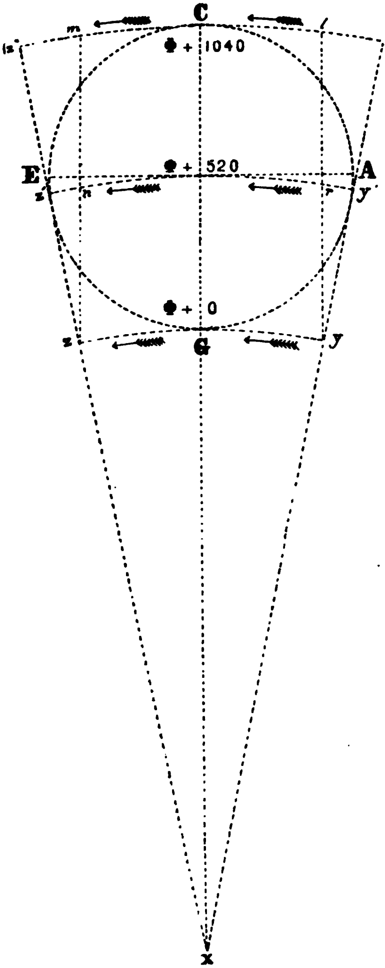

DIAGRAM I. The signification of this diagram is negative. As revelant to the subject of this chapter, it is designed to evince the ineptitude of a nebula's vehicular motion *alone* to induce its rotation.

lm. Therefore the two arcs $y'' l + m z''$ measure the diametric difference of the nebula's vehicular motion. Accordingly, $\Phi + 0$ signifies that the vertex of the nebula's inner hemisphere is moved from y to z in no less time than while the vertex of its outer hemisphere is moved from y'' to z'', and $\Phi + 1040$ signifies that the arc $y'' z''$ measures 1040 million miles more than the arc $y\ z$; the figures as here employed representing millionary units, and 1040 million miles a day being the diametric difference of the Solar Nebula's vehicular motion $= y''\ l + m\ z''$, pertinent to its natal magnitude. But in this diagramic view it is apparent that the greater velocity of C as compared with G has no tendency to beget rotary motion of the nebula, because though C travels 1040 million miles a day faster than G, it has 1040 million miles a day farther to travel; so that, in relation to their common axis, their motion is temporally equal, just like that of the inner and outer hemispheres of the Moon which in circumvolving the Earth only simulates rotation once in a lunation, but verily has no rotary motion. Therefore the genesis of nebular rotation is not imputable to the world's rotation alone; and both this and gravity combined are impotent to induce that, so long as a nebula retains its original bulk. But this is temporary; and *why* it is, as well as *how* the two co-ordinate factors of nebular rotation become functionally effective, is aptly suggested by the subjoined diagram.

The inner circle of Diagram II. represents the Solar Nebula as reduced by gravity one-fifth of its

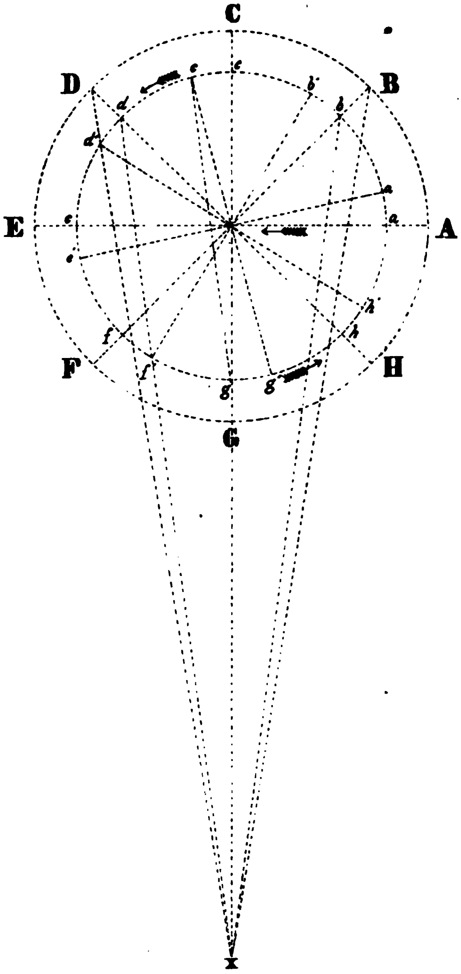

DIAGRAM II. Showing how nebular rotation obtains in effect of the diametric difference of a nebula's vehicular motion coëtaneously with gravity's condensation of its volume.

original dimensions. Accordingly, the extant diametric difference of its vehicular motion is also one-fifth less, and the vertex of its outer hemisphere is *moved* with one-tenth less velocity at *c* than formerly at C. Yet matter now at *c* conserves the momentum of the motion it had at C, and so is bent on *moving* faster than it is *moved*. The like is predicable of the whole quadrant B D. *Per contra*, yet concordantly, the vertex of the nebula's inner hemisphere is now *moved* one-tenth faster at *g* than formerly at G; but matter translated from G to *g* retains only the momentum of its slower passive motion when sojourning at G. The increment of its vehicular motion yields no impetus to the nebula's rotary motion, because its relation to the axis of that is unchanged. The same is true of the whole quadrant F H, and more expressly true of the two adjacent quadrants B H and D F. Therefore the quadrant *B D* is the exclusive base of the alleged tendency of vehicular motion to generate nebular rotation. This is duly ascertained by considering that the trend of vehicular motion is nearly parallel to the line *A E*, in the plane of which, extending to either pole of the nebula, matter is vehicled with the same velocity after as before translation, rendering the center of the nebula virtually static. What is thus said of the plane *A E* is almost equally predicable of the two quadrants which that plane bisects. It thus appears that three-fourths of the bulk of the nebula are negatively disposed to instigate its relation, the transmutation of its vehicular motion being the exclusive mode of generating rotary motion, and the quadrant *B D* being exclusively adapted to mediate this function.

Now, since the vehicular motion of the Solar Nebula in all but the last-named of its quadrants is incommutable, it follows that whatever measure of kinetic energy may accrue from condensation in the quandrant *B D* must wane to zero from the arc *c c'* to the center of the nebula. That identifies the axis of translated motion or nascent momentum with the nebula's center of gravity, and shows it to be impossible that the generated rotary motion should be pivoted elsewhere. Yet a straight line connecting *c'* and g passes the center of gravity at a distance equal to half the chord of arc *c c'*, which measures the incentive to rotary motion. This incentive may not be magnate, but it is irrepressible. It is a positive force germane to a single quadrant to which the three allied quadrants are but neutrally opposed. The inertia of these weighs against, but cannot annul, the kinetic energy with which that is fraught. Innately, one of two speculative possibilities must ensue from the propounded conjuncture. Either the nebula's center of gravity must *move* inherently in the line *A E* half as far as from *c* to *c'*, or the vertex of its inner hemisphere must *move* from g to g'. But we have already seen that the vehicular motion of the nebula's center of gravity is perpetually equable, and therefore cannot acquire momentum in excess of its passive motion. That is to say, it is virtually static. Therefore conclusively, the whole nebula must rotate as from *a* to *a'*, from *b* to *b'*, from *c* to *c'*, and so on to the compass of its equator. And such will be the issue for the same reason for which it is easier to turn a grindstone or move a ponderous body on a pivot than to trundle it on rollers: and what is that? It is that inertia is due to the ether's pressure, which exists more outside than inside a material body. Every globular or cylindrical form of matter is induced by the ether's pressure with two distinctive measures of inertia, distinguishable as internal and external. The *rotation* of such bodies is impeded only by the presence of ether between their atomic constituents, whereas their *translatory motion* (that is in relation to their ethereal vehicle) is resisted by pressure of the ether both inside and outside. Nature's ways are always determined by what is most feasible. So the nebula in the said predicament revolves about its center of gravity, against the less of two impediments, idstead of swaying horizontally as to its bulk against both.

We need not now inquire as to the evidence of the fact which by-and-by will obtrude to apprehension, that the amount of rotary motion accruing from condensation of the Solar Nebula one-fifth of its primal dimensions was 28,274 miles a day. *This is the quantum thereof which would have obtained contemporaneously with the said measure of its condensation by internal gravity, though it had been primarily devoid of rotary motion. But it has been ascertained, and may now be opportunely stated, that the volume of the Solar Nebula, between the epoch of its complete formation and its parturition of Neptune, was condensed more than two-fifths of its natal bulk, its primal radius being shortened 2,385,574,069 miles —from 5,131,835,866 miles to 2,746,263,797 miles; and this occasioned an increase of the nebula's rotary motion of 77,045 miles a day—from 209,937 miles a day, which obtained during its formation, to 286,983 miles a day, as indicated by the daily orbital motion of Neptune. It is ascertained, further-more, that the originally diffuse matter of which the Solar Nebula consisted was collected during a previous era from a spherical portion of environing space whose radius extended from the center of the extant Solar System more than 16 billion miles in all directions therefrom. It was while the said widely-diffused nebulous matter was being aggregated to compose the Solar Nebula, that its rotary motion was progressively generated, from zero to its natal quantum as given above, in effect of the said matter's perpetual gravitation and vehicular motion; the process of nebula formation being analogous to that of its subsequent condensation. Indeed, these were consecutive stages of one and the same achievement of natural causation; and inasmuch as the two factors thereof are apprehended, the mode of their virtual co-operation is conceivable.

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*But as this was its major extreme accumulated from zero, its average from inception was 14,137 miles a day.

Supposing the primordially-diffuse matter with which the pericosm was impleted to be subject to gradual multitudinous segregations by the diverse trends of its dual motivity, as suggested at the beginning of this chapter, it is easy to see that the progressive aggregation of each portion must ensue from its internal gravity, while the very principle of its disseverance from the pericosmic reservoir thereof precludes forever the gravitation of one toward another. Thus the matter of which the Solar Nebula was composed was insulated even prenatally, as seems to be requisite to its conformation.* Postulating that, we find no room for conjecture as to the sequel. There is no calling for the fortuitous *flocculi* of Mr. Spencer's theory hereabout, and therefore no need of precocious chemical action to produce them. It does not require even a nucleus of denser matter, as some have imagined, to determine the central trend of internal gravity in a portion of nebulous matter, however irregular may be its contour; because gravitation is caused by the diminished pressure of ether between material particles, either atomic or molecular, not in proportion to their density, but according to their mass—that which determines the quantity of ether which they displace *by their aggregate of concentric force*, which is essentially-homologous and dynamically-equivalent to the ether which it counterpoises. The solar gravity of the planets were never greater nor less respectively than now, though at birth the nebular antecedent of each was (because of its greater rarity) vastly larger than the extant residuüm of all—the Sun. So the matter of the Solar Nebula was as subordinate to the sway of internal gravity and the antilateral difference of its vehicular motion before as after its conglobation, and prelusively subservient to this end. More than that; the process of nebular formation, by the aggregation and condensation of widely-diffused matter, was indispensable to the emergence of all its later aptitudes in mundane existence. It was not physically necessary that atomic dispersion should be the prime predicament of universal Matter; nor was its subsequent aggregation and condensation *made* necessary by its previous expansion any more than by the scheme of cosmic evolution which it initiated.

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* "Nebulæ are faint misty objects seen in various parts of the firmament, *always maintaining a fixed position*, which resemble comets, or a speck of fog."—*Olmstead.*

Since nebulous matter is devoid of life and without association of its atoms must have remained forever useless, why were the conditions of its utility postponed for ages by the aboriginal rarity of life's material base? There is but one rational answer to this question, and that is suggested by "the Nebular Hypothesis" which the Pericosmic Theory validates. The whole process of cosmic evolution depends on sporadic transmutations of pericosmic motivity to automatic motion throughout the physical world. The translation of passive to active motion in any mass of matter consists in propagating the momentum of a greater velocity of vehicular motion than is current in the region most distant from the axis, and this is feasible only with a gradual lessening of its contour, while the scope of diminution is measured by prelusive expansion. The rarèr a nebula's prenatal material, the statelier will be its adult career, the more prolific may be its function as mediator of traductive motivity, and the more effective finally its residuüm of solar energy. In other words, the broader the atomic dispersion of a given quantum of nebulous matter, the greater is the antilateral difference of its vehicular motion, and so the greater must be the surplus momentum of the one-sided excess thereof which accrues from its condensation and inures to nebular rotation, the *nidus* of which is pregnant with all the ulterior issues of life-bearing planets.

The diversified trend of procentric gravity in the periphery of nebulous matter germane to the formation of the Solar Nebula, by its differentially-angular correlation with the trend of vehicular motion, so modified the process of aggregating said matter as to generate therein a series of spiral drifts thereof wending obliquely toward a common center, as exemplified by the telescopic appearance of the famous whirlpool nebula first discovered by Lord Rosse. Such is the probable mode of nebular formation in general, though its aspect from different points of observation must, for obvious reasons, be multifarious. But the process thereof, however diuternal, is transitional, because its two factors are unequal at first, but verge to equipollence during the era of nebular formation ; and that terminates coincidently with the conglobation of nebulous matter.

The spiral motion of nebulous matter as represented above inchoates with the inceptive transmutation of its vehicular to inherent motion, which at its minimum is dynamically inferior to procentric gravity, but is cumulative, and in proportion as it ekes to parity with its prospective compeer, supplements its nominal predecessor—doffs the guise of spiral motion and dons that of nebular rotation.

The velocity of rotary motion pertinent to the Solar Nebula at the epoch of its spherical conformation is thus identified with the maximum of spiral motion in the matter of its structure during the era of its conformation. Spiral motion differs from rotary motion by trending obliquely toward the center of the nebulous mass to which it pertains; but, by trending less-and-less obliquely, it constantly assimilates the trend of rotary motion, in which therefore it finally culminates, At this conjuncture a nebula is born a perfect sphere. This, at first thought, may seem improbable. The new-born Solar Nebula's alleged rotary motion implies a generation of centrifugal force tending to expand its equator, in which case its axis would be shortened and its polar hemispheres depressed, making it spheroidal rather than spherical. But further reflection suggests a contravention of this predicament. It is conceivable that the form of a nebula must be oval, if subject to vehicular motion exclusively, as it would be were it non-rotating; that, in fact, the excentricity of its outer hemisphere is virtually nullified by its rotary motion, which itself consists of the transmuted diametric difference of its vehicular motion divided and re-invested equally as to its hemispheres in a manner to preclude its otherwise oval form and ordain it's primordial sphericity. But this is not a permanent attribute of any nebula. It is in no case more lasting than the equipollence of its two factors; and that obtains only at the completion of nebular formation. Prior to this juncture, the procentric gravity of nebulous matter is dominant; subsequently, almost to the finale of nebular condensation, the centrifugal bent of nebular rotation is successively victorious in competition with procentric gravity, and this makes the life-long shape of a nebula continuously transitional from spherical to discoidal.

CHAPTER VI.

CUMULATIVE MOMENTUM IN THE BIRTH OF THE SOLAR SYSTEM.

A notable characteristic of nebular rotation when inaugurated is its continuous acceleration from the beginning to the end of a nebula's transformation to a planetery system. If that is apparently less puzzling to students of cosmic evolution than the origin of nebular rotation itself, it cannot be because its rationale is more obvious, but rather because of its greater overtness as a patent fact brought to light by observation, instead of a latent truth suggested only by rational reflection. This is the probable reason why most astronomers make no attempt to explain it, or else unwittingly affect its explication by refering it to "Kepler's laws," as if these were the finality of relevant inquiry. But without questioning the verity of those laws—admitting their virtual ascendancy in the motoric order of the universe, is there no ulterior reason for their supremacy? "Laws are not causes," and the law of gravitation is not gravity. "Gravity *must be caused* by an agent acting according to certain laws," was the deductive thought of Newton, who discovered, not gravity nor gravitation (which were known by mankind before his day), but the universality of their *cause* and the *law* of its operation: the word *law* as applied to natural phenomena being another term for *unvarying order*; unvarying because unvariable. Hence the conclusion that the base of natural law is relative necessity. But of necessity there are different species as well as subjective phases, and that presented to the intellective vision of Kepler regarding planetary motion is not exclusively conceptive, nor the only one available to scientific research. Of course, if the planets did not move fast in proportion as they are near the Sun, they would in time fall into his mass; but this is not the reason why they move as they do. Kepler's laws so-called are not arbitrary, but absolute—not enacted for the nonce by the Author of Nature, but explicable as necessary truths. Neptune moves slower than Uranus for the same reason as why its orbit is larger —because its nebular parent was more bulky at the time when the first planet was evolved, and had not acquired the velocity of rotation which it had at the birth of the second planet: a merely negative cause, yet involving a physical necessity. The substance of every planet was for ages during the period of its prenatal existence falling toward the place of the subsequent Sun, in effect of gravity, yet held aloof therefrom by the elasticity of its colliding atoms. But these two principles were incompetent to generate the rotation of the mass in which they resided; though their co-operation was auxiliary to this end in conjunction with the vehicular motion of matter. Without this pleliminary and perpetual factor in the process of nebular transformation, there is no probable way to account for either the genesis of nebular rotation or its cumulative velocity.

The following argument hinges on the cosmologic intelligence that all the planets of the solar system are related to the Sun as the paramount issue of their common progenitor whose historic form is properly named the Solar Nebula.

It is scientifically ascertained that the youngest planet of the solar system moves in its orbit nine times as fast as the oldest; the orbital motion of Neptune being 11,957 miles an hour, that of Uranus 14,962, of Saturn 21,210, of Jupiter 28,733, of Ceres 39,399, of Mars 53,090, of the Earth 65,534, of Venus 77,056, and of Mercury 105,331 miles an hour; so that Neptune moves four-fifths as fast as Uranus, three-fifths as fast as Saturn, two-fifths as fast as Jupiter, two-sevenths as fast as Ceres, two-ninths as fast as Mars, one-fifth as fast as the Earth, one-seventh as fast as Venus, and one-ninth as fast as Mercury. Yet the Sun's rotary motion is slower than the orbital motion of any of his planetary offspring, being only 4,392 miles an hour—less than one-third the orbital motion of the oldest planet and little more than one-twenty-fourth that of the youngest. *Why is this?* Whence the increasing motivity which thus augments the orbital motion of planets from the circumference to the center of the solar system? and why is its culmination in the youngest planet lost to the Sun? Since it trends toward the center, why should it not culminate in the Sun rather than in the last-born planet? To answer these questions in reverse order, it may be said—

1. Because the substance of the Sun has reached that stage of condensation which does not admit of inter-atomic space sufficient for the rebound of atoms from collision so far as is requisite to the formation of an equatorial ring as the prenatal figure of a planet; which predicament, by the way, insinuates the presumption that its further condensation depends mainly upon its superficial radiation of heat, the loss of which in that way may not greatly exceed its constant supply by the fall of foreign matter on its surface. But the question admits of a more comprehensive answer. The Sun's rotary motion on its extant equator is 105,410 miles a day; but the solar substance which at the birth of Mercury was posited 425,000 miles from the Sun's centre moved only 30,345 miles a day. So the equator of Mercury's nebular parent moved 2,527,948 miles a day, though the Solar Nebula at that time rotated but once in 87·96 days. The Sun now rotates once in 25 1-3 days, yet its rotary motion is but about one-twenty-fourth of what it was at the birth of Mercury; and for this reason:

2. By condensation of the Solar Nebula since its parturition of Mercury, its more-rapidly-moving matter has been mingled with the less-rapidly-moving matter thereof, and the momentum of the former has been compounded with the inertia of the latter in a way to effect their motoric equilibrium. This issue of nebular condensation was not unique and germane

exclusively to the upshot of its process, but pertinent to all stages thereof, though an adventitious characteristic of each, obtaining more and more expressly from the first to the last, the compromise of the momentum of exterior matter by the inertia of interior matter becoming exorbitant in proportion as the radius of nebular rotation was curtailed. This is the main if not the only reason why the rotary motion of the Solar Nebula's residue has waned continuously since the birth of Mercury, while it now rotates three-and-three-fifths as often as then only because its equator has become but one-eighty-third as large.

3. The successively greater orbital motion of junior than of senior planets was predetermined by similar accelerations of the Solar Nebula's rotary motion from the first to the last of its planetary parturitions; the orbital motion of each planet being traductive from, and exactly measured by, the rotary motion of its nebular parent. Thus the nine grades of orbital motion displayed in the solar system are identified with as many translations of the Solar Nebula's rotary motion, which itself consisted of the transmuted rotary motion of the pericosm. Now the rotary motion of the pericosm was the product of two factors which, in view of their digressive drift, cannot be regarded as congenital. Yet their co-efficiency implies their correlation and virtual biunity in such wise as appears expoundable only by imputing the one to the ether's pressure and the other to the rotation of the ether's volume. With this conception of their distinctive origin and consistence,

whereby they are rendered incompoundable, while their functional co-efficiency is made permanent by the oneness of their base, their coëval and finally equal augmentation as co-ordinate factors of planetary evolution, during the era of the Solar Nebula's condensation, is readily accounted for. The increase of its procentric gravity was due to the diminution of distance between each later-born planet and the centre of the nebulous mass out of which it was evolved; or rather it was due to the diminishing excentric pressure of ether within the nebula anent the ether's unvarying concentric pressure from its outside; while the projectile factor of the Solar Nebula's rotation was continuously augmented during the condensation of its volume, a special aggregate of its supplement being transmitted to the germ of each consecutive planet as the projectile factor of its orbital motion.

The process according to which this part of nebular transformation is effected is indescribable apart from the greater process to which it appertains.

Transmutation of the surplus momentum of a nebula's vehicular motion to its inherent rotary motion initiates with the aggregation and spiral motion of nebulous matter, and progresses during the era of the nebula's spherical conformation. This is the first link in the chain of its serial mutations whence ensues in course of time the gradual translocation of its inner and outer hemispheres. When that occurs, the outer hemisphere conserves the momentum of its previous greater vehicular motion with which the inner hemisphere now begins to be indued; and when the nebula has made a complete rotation, its rotary motion will have been enhanced in a manner proportional to the original diametric difference of its vehicular motion. The gain of rotary motion in virtue of hemispheric transposition is successively incrementive, the ultimate velocity of each nebular rotation being greater than the preceding one, until the centrifugation of nebulous matter, abetted by its atomic elasticity, finally culminates in an equatorial ring as the prenatal form of a nascent planet. This event is of course preceded by an extreme expansion of the nebula's equatorial rim, to the matter of which the contacting part of the nebula adheres with a tenacity to be overcome only by the superior stress of the nascent ring's proclivity to withdraw. To that the nebula's internal gravity is persistently opposed, and, as if unwilling to let go the eloping part of its own substance, holds it fast, yet only to be drawn after it to the verge of separation which nevertheless takes place inevitably in virtue of its rival's growing and finally prevailing energy, seconded at last by the lessened gravity which has weakened hitherto in proportion to the nebula's equatorial expansion.

The revolving ring thus seggregated from the equatorial rim of a nebula, being differentially-motoric in effect of the diametric difference of its vehicular motion, is weightier at the point of its slowest motion than elsewhere and comparatively slender at the opposite point which moves most rapidly, where in time it is bound to break preparatively to its lateral contraction both ways therefrom toward the point of its slowest motion, there to conglobate. Thenceforth the new planet circumvolves its nebular parent in an orbit predetermined by the size and attitude of its prenatal form with a velocity just equal to the conserved momentum of its last motoric antecedent. This it is enabled to do by appropriating the surplus revenue of nebular rotation, which is but a part, though a very considerable part of the surplus momentum of the nebula's vehicular motion.

When the aforesaid parturition is completed, the residual part of the nebula relapses from a discoidal to a spheroidal form, conserving not only so much of the surplus momentum of its own vehicular motion as matches the increment of gravity occasioned by its last metamorphosis, but vastly more — so much of that as will make the projectile factor of its extant rotary motion equipollent with its acquired increment of procentric gravity. Procentric gravity increases *pari passu* with nebular condensation, which yields a surplus momentum of vehicular motion inuring to nebular rotation. But the increase of procentric gravity is only proportional to the decrease of the radius of nebular condensation, whereas the surplus momentum of a nebula's vehicular motion is proportional to the diametric difference of its vehicular motion, which measures diurnally about a tenth of its whole diameter. The procentric gravity of the Solar Nebula was continuously enhanced from the day of its conglobation to the end of its condensation; while the excentric factor of its evolution was at intervals as much more largely reinforced as is represented by the aggregate orbital motion of all the planets.

The diametric difference of a nebula's vehicular motion is continuously lessened by condensation of its volume; and when the rotary motion of a nebula becomes equal to the dimished diametric difference of its vehicular motion, a surplus momentum of the latter is no longer generated, and so there is an end of its transmutation. The Sun's rotary motion now exceeds the diametric difference of its vehicular motion by nearly 16,000 miles a day, and became equal to it a long time ago, approximatively at the birth of Mercury, when the avails of the Solar Nebula's mediative function ceased to be transmissible and became wholly cumulative within itself. Yet the function of a nebula is not one of inherent utility. Its very existence is utile only as the fulcrum of its specific mutation, the lever to which is not its durability but rather its transientness. The Solar Nebula was not an originator of motion or motive power, but a mere mediator of pericosmic motivity. Nine times from first to last it played the parental part imperfectly described above, in each case transmitting the major part of its vehicled energy to the annular germ of a planet, and cherishing a cumulative portion thereof only in behalf of its nutrimental function as placenta to the embryonic Sun, the diuternal and pre-eminent energy of which is mainly due to the fact that much of its matter has fallen to its present position from a region remotely distant from the Solar Nebula's surface. It will appear in the drift of the next chapter that the sphere of space to which the matter of the solar system is indigenous is not less than 45 billion miles in diameter.

CHAPTER VII.

TRANSLATION OF PERICOSMIC MOTIVITY TO THE ORBITAL MOTION OF PLANETS BY MEANS OF NEBULAR CONDENSATION.

The significance of the fact that all the orbits of the Solar System are homocentric is commonly overlooked, and must be by all sober advocates of a sporadic origin of the planets. There is not a shadow of probability that each member of a family so appositely collocated as those of our Sun's dependents should have been born apart and casually emigrated thither from foreign regions. But, in rational contrast to such a notion, their congeneration by a single nebular parent is evinced by scientific recognition of the unexceptional proportion which obtains between all the elements of any two planets. We have a glimpse of this in what is called "Kepler's third law" thereof, which for many generations has been inculcated in schools and school-books with no attempt to explain it otherwise than in terms of affirmation. How Kepler worded it I do not know, but the translators and compilers of his thought have reported it as susceptible of diverse formulas. *E. g.*: "The squares of the periodic times of any two planets are proportioned to the cubes of their mean distances from the Sun." "If the squares of the times of revolution of the planets round the Sun be divided by the cubes of their mean distances, the quotient will be the same for all the planets." The former of these two citations is from *Burritt's Geography of the Heavens* and the latter from *Elementary Lessons in Astronomy* by Lockyer, who supplements the formula as follows:

"The third law shows that the periodic time of a planet and its distance from the Sun are in some way bound together, so that if we represent the Earth's distance by 1, we can at once determine the distance of, say, Jupiter from the Sun, by a simple proportion, thus:

$$1 \times 1 : 11{\cdot}86 \times 11{\cdot}86 :: 1 \times 1 \times 1 : 140{\cdot}559 \; .$$

"That is, whatever the distance of the Earth from the Sun may be, the distance of Jupiter is $\sqrt[3]{140}$ times greater."

"In some way bound together:" This inexact averment regarding an element of physical science connotes no apprehension of its consistence and no ability to probe it. Though none but for ignorance may doubt its reality, it is generally supposed to be inexplicable. Nevertheless, I believe its physical cause is amenable to scientific research. In the first place, it admits of a more explicit formula than I have met with in any book. I prefer this:

As the cube of the radius of a senior planet's orbit to the cube of the radius of a junior planet's orbit, so is the square of the given senior planet's periodic time to the square of the given junior planet's periodic time.

This theorem is verified by performing the arithmetical process indicated below, which is based upon the orbital elements of Mercury and Venus:

$$\frac{(66131)^3}{(35393)^3} = 65234 = \frac{(224{\cdot}6826)^2}{(87{\cdot}9698)^2} = 6{\cdot}5234.$$

"Seeing is convincing," whether the object of vision be physical or mental. That to which the reader's attention has just been directed may have the guise of novelty, though essentially old. Without losing sight of that, I want cosmologic inquirers to see another phase of the same verity, which to me, if not to everybody, is altogether new. The last written formula of "Kepler's third law" is but the arithmetical converse of its ordinary statement. The one is as inexplicable as the other, or rather be it said both are explicable according to one and the same principle; and to this I have a clew. It consists with the conception that the law which Kepler and his disciples have predicated exclusively of the orbital motion of planets, is also predicable of the Solar Nebula, of which, with retrospective insight of cosmic evolution, it may be said—

As the cube of the radius of a senior planet's nebular antecedent to the cube of the radius of a junior planet's nebular antecedent, so is the square of the Solar Nebula's period of rotation at the time of the given senior planet's annular seggregation therefrom to the square of the Solar Nebula's period of rotation at the time of the given junior planet's annular segregation therefrom.

The reader's näive suspicion that my parody of Kepler's discovery is purely subjective, or founded in ideal speculation, can be dissipated only by scientific discernment of its physical reality. Yet the conventional apprehension of a latent truth underlying that of perception in the case, can by no means be dissipated. That this truth is identifiable with that which correlates the two homologous theorems presented above, is at once rendered probable by the fitness of the latter to account for the former. And since their correlation is not one of coincidence, but of consecution—that of antecedant and consequent, that pertaining to the Solar Nebula is causative of that pertaining to planets, whose orbital motion must be regarded as simulating nebular rotation, instead of this conforming to that; the two phases of motivity being dynamically one—that of orbital motion being no other than the translated momentum of nebular rotation. Positive evidence of this is forthcoming, but mediate thereto is another theorem cognate to the foregoing, to which the same elements of planetary motion are relevant, though the mathematical requirements of this are discrepant from its essential analogue. I am not aware that the following example of compound proportion has ever been published.

As the orbit of a junior planet to the orbit of a senior planet, and as the orbital motion of the given senior planet to the orbital motion of the given junior planet, so is the periodic time of the given junior planet to the periodic time of the given senior planet.

Example as to the Earth and Jupiter.

$$\left.\begin{matrix} 91437 & : & 475617 \\ 689601 & : & 1572820 \end{matrix}\right\} :: 365{\cdot}2563 : 4333{\cdot}58.$$

Verbally: As radius of the Earth's orbit to radius of Jupiter's orbit, and as Jupiter's orbital motion to the Earth's orbital motion, so is the Earth's periodic time to Jupiter's periodic time.

The physical base of this theorem is the same as that of Kepler's discovery, and, like that, it admits of explication only as the translated momentum of nebular rotation, thus:

As the radius of the Solar Nebula's equator at the birth of a junior planet was to the radius thereof at the birth of a senior planet, and as the rotary motion of the Solar Nebula at the birth of the senior planet was to its rotary motion at the birth of the junior planet, so was the Solar Nebula's period of rotation at the birth of the junior planet to its period of rotation at the birth of the senior planet.

This new theorem of no reputation as to either domain of its objective application rivals that of conventional acceptance three centuries old, by its purport of mechanical equivalence assignable to the extant and pre-ordinate subjects of both, to wit: the perceptive part and conceptive counterpart of its physical base. It is another aspect of "Kepler's third law," but of superior suggestion and compliance to the same purpose as that favored by its harbingers.

Though more practical than any former version thereof, it must yield precedence to the following, which for explicitness and arithmetical aptitudes is unrivaled.

The ratio of a senior planet's orbit to a junior planet's orbit is equal to the square of the ratio of the junior planet's orbital motion to the senior planet's orbital motion.

And so conversely —

The square root of the ratio of a senior planet's orbit to a junior planet's orbit is equal to the ratio of the junior planet's orbital motion to the senior planet's orbital motion.

Application of this theorem to any two primary planets of the Solar System is followed by relatively the same resultant, examples of which are given below. These represent a novel means to the same astronomic purpose as that commended by Lockyer cited near the beginning of this chapter; and I am willing the reader should judge whether or not its mathematical employment be less toilsome.

The Earth and Mercury.

$\frac{91431560}{35393068}=2{\cdot}5832183$, the square root of which is $1{\cdot}60727045$; and this is the ratio of Mercury's orbital motion to the Earth's orbital motion, as $\frac{2527948}{1572820}=1{\cdot}60727045$.

The Earth and Venus.

$\frac{91431}{66131}= 1{\cdot}38257398$, the square root of which is

1·1758 ; and this is the ratio of Venus's orbital motion to the Earth's orbital motion as $\frac{1849362}{1572820} = 1\cdot\text{-}1758$.

The Earth and Mars.

$\frac{139314}{91431} = 1\cdot5237064015$, the square root of which is 1·23438; and this is the ratio of the Earth's orbital motion to the orbital motion of Mars, as $\frac{1572820}{1274177} = 1\cdot23438$.

The Earth and Ceres.

$\frac{252959}{91431} = 2\cdot7666657$, the square root of which is 1·6633; and this is the ratio of the Earth's orbital motion to the orbital motion of Ceres, as $\frac{1572820}{945561} = 1\cdot6633$.

The Earth and Jupiter.

$\frac{475616831\cdot964}{91431560\cdot158} = 5\cdot201898$, the square root of which is 2·280767; and this is the ratio of the Earth's orbital motion to Jupiter's orbital motion, as $\frac{1572820\cdot7556}{689601\cdot349} = 2\cdot280767$.

The Earth and Saturn.

$\frac{872135}{91431} = 9\cdot538723$, the square root of which is 3·08848; and this is the ratio of the Earth's orbital motion to Saturn's orbital motion, as $\frac{1572820}{509254} =$ 3·08848.

The Earth and Uranus.

$\frac{1753912}{91437}=19{\cdot}1829108289$, the square root of which is 4·37983; and this is the ratio of the Earth's orbital motion to Uranus's orbital motion, as $\frac{1572820}{359105}=4{\cdot}37983$.

The Earth and Neptune.

$\frac{2746263797}{91431560}=30{\cdot}036278468835$, the square root of which is 5·4805363; and this is the ratio of the Earth's orbital motion to Neptune's orbital motion, as $\frac{1572820{\cdot}7556}{286983}=5{\cdot}4805363$.

The theorem thus concretely verified is germane to the same cosmic principle as are the two preceding, and like them admits of no other gist of explication than that which applies to its conceptive counterpart, to wit:

The ratio of the radius of the Solar Nebula's equator at the birth of a senior planet to the radius thereof at the birth of a junior planet is equal to the square of the ratio of the Solar Nebula's rotary motion at the birth of the junior planet to its rotary motion at the birth of the senior planet.

Postulating the parity of each planet's orbit with the equator of its nebular parent, this conceptive counterpart of the verified theorem is likewise verified by the subjoined series of planetary proportions.

Uranus and Neptune.

The ratio of Neptune's orbit to Uranus's orbit is $\frac{2746263}{1753912} = 1{\cdot}56579$, the square root of which is 1·251316; and this is the ratio of Uranus's orbital motion to Neptune's orbital motion, as $\frac{359105}{286983}$ $=1{\cdot}251316$.

Saturn and Neptune.

The ratio of Neptune's orbit to Saturn's orbit is, $\frac{2746263}{872139} = 3{\cdot}148882$, the square root of which is 1·7745; and this is the ratio of Saturn's orbital motion to Neptune's orbital motion as $\frac{509254}{286983} = 1{\cdot}7745$.

Jupiter and Neptune.

The ratio of Neptune's orbit to Jupiter's orbit is $\frac{2746263797}{475617885} = 5{\cdot}774097$, the square root of which is 2·402934; and this is the ratio of Jupiter's orbital motion to Neptune's orbital motion, as $\frac{689601{\cdot}340}{286983}$ $= 2{\cdot}402934$.

Ceres and Neptune.

The ratio of Neptune's orbit to the orbit of Ceres is $\frac{2746263}{252960} = 10{\cdot}856510$, the square root of which is 3·2949; and this is the ratio of Ceres's orbital motion to Neptune's orbital motion, as $\frac{945587}{286983} = 3{\cdot}2949$.

Mars and Neptune.

The ratio of Neptune's orbit to Mars's orbit is $\frac{2746263}{139314} = 19{\cdot}712756$, the square root of which is 4·4399; and this is the ratio of Mars's orbital motion to Neptune's orbital motion, as $\frac{1274178}{286983} = 4{\cdot}4399$.

The Earth and Neptune.

The ratio of Neptune's orbit to the Earth's orbit is $\frac{2746263}{91431} = 30{\cdot}036278$, the square root of which is 5·48053; and this is the ratio of the Earth's orbital motion to Neptune's orbital motion, as $\frac{1572820}{286983} = 5{\cdot}48053$.

Venus and Neptune.

The ratio of Neptune's orbit to Venus's orbit is $\frac{2746263797}{66131862} = 41{\cdot}5270$, the square root of which is 6·4441; and this is the ratio of Venus's orbital motion to Neptune's orbital motion, as $\frac{1849262}{286983} = 6{\cdot}4441$.

Mercury and Neptune.

The ratio of Neptune's orbit to Mercury's orbit is $\frac{2746263797}{35393068} = 77{\cdot}5932676+$, the square root of which is 8·80870408259; and this is the ratio of Mercury's orbital motion to Neptune's orbital motion, as $\frac{2527948{\cdot}232734}{286983} = 8{\cdot}80870408259$.

Thus it appears that the planets respective ratios of distance from the Sun are consecutively as 1, 3, 5, 10, 19, 30, 41, 77, nearly, from Neptune to each later-born planet; which series differs inconsequentially from that of the orbital ratios of adjacent planets, otherwise found to be 1·4, 2, 1·8, 1·8, 1·8, 1·5, 1·4, 1·8, nearly, from Neptune to Mercury, the unit of the latter measurement being the orbit of each later-born planet. These two series of orbital ratios concur in implying that if the Solar System included an older planet than Neptune, its orbit would probably exceed that of Neptune rather more than Neptune's orbit exceeds that of Uranus. But Neptune, having no planetary antecedent, holds the same relation to the Solar Nebula's prime equator as it would have held to the orbit of an elder planet. Therefore—

As the ratio of Neptune's orbit to Venus's orbit *is* to the ratio of Neptune's orbit to Mercury's orbit, so the ratio of Neptune's orbit to Mercury's orbit *is* to the ratio of the Solar Nebula's prime equator to Mercury's orbit.

This proportion, as will come to light in the sequel is proximately as stated below.

$$41{\cdot}52 : 77{\cdot}59 :: 77{\cdot}59 : 144{\cdot}995378.$$

Multiplying the 4th term of this proportion by the radius of Mercury's orbit gives the radius of the Solar Nebula's prime equator, thus:

$$144{\cdot}995378 \times 35393068 = 5{,}131{,}831{,}273.$$

This deduction from general principles is not to be regarded as an exact estimate of the Solar Nebula's equatorial radius when first conglobated. Yet it is approximately correct and happily supplementable by another method of astronomic mathematics based on specific elements of the solar system otherwise ascertained. It was stated in Chapter V. that the radius of the Solar Nebula's prime equator measured 5,131,837,866 miles. That is 6,573 miles more than the number figured out above. To furnish this complement and prove the truth of the former statement, the following four theorems are opportunely availaable.

1. The product of the square of the ratio of the Earth's daily orbital motion to Neptune's daily orbital motion multiplied by the radius of the Earth's orbit, is equal to the radius of Neptune's orbit. Elucidated thus:

$$1572820{\cdot}7556 \div 286983 = 5{\cdot}480536323.$$
$$(5{\cdot}480536323)^2 = 30{\cdot}0362783877236.$$
$$30.03627838772 \times 91431560{\cdot}258 = 2746263797{\cdot}333.$$

2. The product of the square root of the ratio of Neptune's orbit to Mercury' orbit multiplied by Neptune's daily orbital motion, is just equal to the product of the square root of the ratio of the Solar Nebula's prime equator to Mercury's orbit multiplied by the Solar Nebula's primal rotary motion *per diem*; and either product is equal to the daily orbital motion of Mercury. Elucidated thus:

$$2746263797 \div 35393068 = 77{\cdot}5932676146377.$$
$$\sqrt{77{\cdot}5932676146377} = 8{\cdot}80870408259.$$
$$8{\cdot}80870408259 \times 286983 = 2527948{\cdot}323734.$$

5131837866 ÷ 35393068 = 144·995527264231.

$\sqrt{144{\cdot}99556427264231} = 12{\cdot}04141039.$

12·04141039 × 209937·892743 = 2527948·323734.

3. The square of the ratio of Mercury's daily orbital motion to the primal rotary motion of the Solar Nebula *per diem* multiplied by the radius of Mercury's orbit, is equal to the radius of the Solar Nebula's prime equator. Elucidated thus:

2527948·323734 ÷ 200937·892743 = 12.04141039383.

$(12{\cdot}04141039383)^2 = 144{\cdot}99556427264231.$

144·99556427264231 × 35393068 = 1,131.837,866·-9069.

4. The primal rotary motion of the Solar Nebula *per diem* was equal to the quotient of Neptune's daily orbital motion divided by the square root of the ratio of the Solar Nebula's prime equator to Neptune's orbit. Elucidated thus:

5131837866·6069 ÷ 2746263797·331=1·8686616601.

$\sqrt{1.8686616601} = 1{\cdot}36699.$

286983 ÷1·36699 = 209937.892743. And

209937.892743 × 1·36699 = 286983·00000065357.

Now we have the mathematical means for finding the elements of proportion which have obtained between each planet of the solar system and the prime equator of their common nebular parent, which are respectively as follows seriatim.

Neptune and the Solar Nebula.

The ratio of the Solar Nebula's prime equator to Neptune's orbit is as 5131837866 ÷ 7274626379 = 1·8686616601 the square root of which is 1·36699;

and this is the ratio of Neptune's orbital motion to the prime rotary motion of the Solar Nebula, as 286983 ÷ 209937·892743 = 1·36699.

Uranus and the Solar Nebula.

The ratio of the Solar Nebula's prime equator to the orbit of Uranus is as 5131837866 ÷ 1753927090 = 2·9259128809, the square root of which is 1·71053; and this is the ratio of Neptune's orbital motion to the prime rotary motion of the Solar Nebula, as 259105 ÷ 209937 = 1·71053.

Saturn and the Solar Nebula.

The ratio of the Solar Nebula's prime equator to the orbit of Saturn is as 5131837 ÷ 872139 = 5·8842, the square root of which is 2·42573; and this is the ratio of Saturn's daily orbital motion to the prime rotary motion of the Solar Nebula *per diem*, as 509254 ÷ 209937 = 2·42573.

Jupiter and the Solar Nebula.

The ratio of the Solar Nebula's prime equator to Jupiter's orbit is as 5131837 ÷ 475617 = 10·789852, the square root of which is 3.28479; and this is the ratio of Jupiter's daily orbital motion to the prime rotary momotion of the Solar Nebula *per diem*, as 689601 ÷ 209937 = 3·28479.

Ceres and the Solar Nebula.

The ratio of the Solar Nebula's prime equator to the orbit of Ceres is as 5131837 ÷ 252960 = 20·28710667781, the square root of which is 4·504121; and this is the ratio of Ceres's orbital motion to the prime rotary motion of the Solar Nebula, as 945587 ÷ 209937.89 = 4.504121.

Mars and the Solar Nebula.

The ratio of the Solar Nebula's prime equator to the orbit of Mars is as 5131837866 ÷ 139314032 = 36·83647506, the square root of which is 6·0693; and this is the ratio of Mars's daily orbital motion to the prime rotary motion of the Solar Nebula *per diem*, as 1274178 ÷ 209937·89 = 6·0693.

The Earth and the Solar Nebula.

The ratio of the Solar Nebula's prime equator to the Earth's orbit is as 5131837866 ÷ 91431560 = 56·127641, the square root of which is 7·49183; and this is the ratio of the Earth's daily orbital motion to the prime rotary motion of the Solar Nebula *per diem*, as 1572820·7556 ÷ 209937·892743 = 7·49183.

Venus and the Solar Nebula.

The ratio of the Solar Nebula's prime equator to Venus's orbit is as 5131837866 ÷ 66131862 = 77.600081, the square root of which is 8·809; and this is the ratio of Venus's daily orbital motion to the prime rotary motion of the Solar Nebula, as 1849362 ÷ 209937·89 = 8·809.

Mercury and the Solar Nebula.

The ratio of the Solar Nebula's prime equator to Mercury's orbit is as 5131837866 ÷ 35393068 = 144·995564, the square root of which is 12·04141039; and this is the ratio of Mercury's daily orbital motion to the prime rotary motion of the Solar

Nebula, as 2527948·323734 ÷ 509937·892743 = 12·04141039.

According to the foregoing exposition, the Solar Nebula's prime equator measured 32,244 million miles, and was rotating nearly 209,938 miles *per diem*, making a complete rotation in about 420 years; this measure of its rotary motion being due to the momentum of its former spiral motion during the era of its material aggregation in effect of its unequal vehicular motion seconded by its gravitation. The sphere of space to which the matter composing the Solar Nebula was indigenous, is limited and proximately measurable according to the subjoined theorem.

The product of the square of the ratio of the Solar Nebula's primal rotary motion to the increment thereof between the epoch of its conglobation and the birth of Neptune multiplied by the decrement of its radius by condensation of its volume during the same era, is equal to the depth of exterior space made vacuous by aggregation of its matter before conglobation; and this, plus the prime radius of the Solar Nebula, is equal to the radius of the sphere of space within which the matter composing the Solar Nebula, now transformed to the solar system, was and is insulated.

Premising that, between the epoch of the Solar Nebula's conglobation and its parturition of Neptune, its prime radius was lessened from 5,131,837,866 to 2,746, 263,797=2,385,574,069 miles, while its primal rotary motion was coëtaneously increased from 209,-

937·89 to 286983=77,045 miles a day, the theorem is elucidated thus :

209937·89 ÷ 77045 = 2·724873; $(2·724873)^2$ = 7·420176 ; 2385574069 × 7·42 = 17,750,759,591 ; 17,760,759,951 + 5,131,837,866 = 22,882,597,457 ; 22,882,597,457 × 2 = 45,765,194,914.

Hereby is verified the closing remark of chapter VI. that the sphere of space to which the matter of the solar system is indigenous is not less than 45 billion miles in diameter.

The complement of this chapter must be the rationale of its subject-matter. Why the orbits and orbital motions of every two planets of the solar system are correlated, in duplex proportion as discovered above, is intelligible only in the light of the following propositions.

1. In general terms, the translation of pericosmic motivity to nebular rotation and thence to the orbital motion of planets, initiates with the spiral motion of invisibly-diffuse matter and proceeds continuously, not only during the formation of a nebula, but beyond that, incrementally, to the birth of the latter's successive progeny, from the oldest to the youngest member of a planetary class. In other words, the orbital motion of planets in the solar system is due to the surplus momentum of its unequal vehicular motion, *alias* transmuted rotary motion of the pericosm.

2. The antenatal form of each planet of the solar system was a revolving ring whose immediate antece-

dent was the equatorial rim of the Solar Nebula which itself retired from its embryonic offspring in effect of condensation by gravity; while the ring, as the germ of a planet, during the process of its subsequent conglobation, and thenceforth, continued to move in the same path and with the same velocity as in its annular form. Therefore—

3. The orbit of each planet of the solar system is an index to the equatorial circumference of the Solar Nebula at the nativity of each planet respectively, and the orbital motion of each planet is also an index to the rotary motion of its special nebular antecedent. *Ergo, a priori atque a posteriori*—

4. The orbital motion of each planet of the solar system is the translated rotary motion of its special nebular antecedent, the momentum of which was innately transmitted, being immanent with the substance of its antenatal germ; and the rotary motion of the Solar Nebula was always increasing in proportion to the continuous condensation of its volume by procentric gravity whereby a modicum of the rotary motion of its ethereal vehicle was gradually commuted to that of the Solar Nebula. At the same time, the motivity of gravity's physical agent is inversely proportional to the square of the distance through which it operates. Therefore, and mainly for no other reason—

5. The orbital motion of a primary planet is inversely proportional to the dimensions of its orbit, and the ratio of that of a junior planet to that of a senior planet is equal to the square root of the ra-

tio of the radius of a senior planet's orbit to the radius of a junior planet's orbit.

The gist of this explication is germane to the esoteric principle of "Kepler's third law" of planetary motion, the inveterate mystery of which is hereby dispelled.

CHAPTER VIII.

RUDIMENTS OF THE EARTH'S ORBITAL MOTION.

No theory of planetary motion is properly called scientific which fails to recognize and explicate the following astronomic truths:

1. The annual and diurnal periods of the Earth's orbital and rotary motions are unvarying.

2. The Earth is nearly three and one-fourth miles nearer the Sun the first of January than the first of July.

3. The Earth moves with increasing velocity from the point of its greatest to that of its least distance from the Sun, and hence thither with diminishing velocity.

4. The mean velocity of the Earth's orbital motion is 1572820 miles daily; but the maximum thereof is 30,599 miles greater and its minimum 30,599 miles less than its mean, that is per day; the daily increment or decrement thereof being in average 335·0962 miles.

5. The Earth is a little more than one day and one-third of a day longer in moving from its apohelion to its perihelion than from this to that.

6. The Sun is permanently distant from the center of the Earth's orbit nearly one-fifty-sixth of the orbit's radius, or 1,623,862 miles.

7. The Earth's orbital transposition causes the Sun to appear over seven and two-thirds days longer north of the terrestrial equator than south of it, annually.

8. Summer is a little more than two-thirds of a day longer than Spring. Autumn is a little less than two-thirds of a day longer than Winter. Spring is over three and four-fifths, and Summer is over four and one half days longer than Winter. But Summer and Autumn together are less than one day and three-eighths of a day longer than Winter and Spring.

9. These seasonal divisions of the terrestrial year are coincident with corresponding divisions of the Earth's orbit which are analogously unequal.

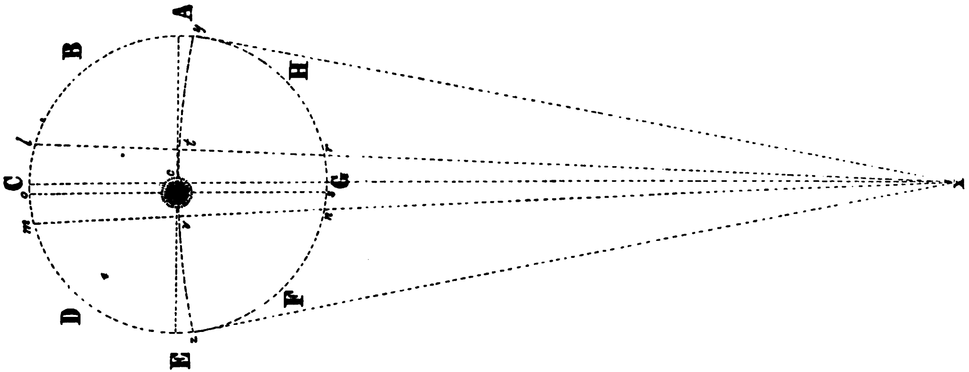
10. The seasonal divisions of the terrestrial year, as well as the arcs of the Earth's orbit appropriate to them respectively, are correlated in arithmetical proportion.

In this chapter it is proposed to find the rationale and collective congruity of the said attributes of the Earth's orbital motion all of which (except the tenth) are generally recognized, though their causative principle has never been brought to light. In the schools of science it is conventionally imputed to the form of the Earth's orbit, which is said to be elliptical, apparently because the two factors of its orbital motion are unstably counterpoised; though *why they should be* is inconceivable. There will be no need of arguing against this untenable assumption, if I succeed in my attempt to show that all the vicissitudes of the annual cycle of our terrestrial world noted above, necessarily ensue from the vehicular motion of the Earth and Sun.

A planet's orbital motion is the resultant of three specific forces, two of which are co-ordinately essential thereto, namely, the centripetal and the projectile; these two primordial factors thereof being subject to modification solely by the planet's varying vehicular motion. The first of these three forces, *solar gravity*, varies only as a planet, from any cause, gets nearer to or farther from the Sun, (which can happen only in effect of some extraneous bias); otherwise, it must be as constant as the ether's pressure. The second, the planet's *projectile impetus*, being traductive from the rotation of its nebula parent, must also be a constant quantity *per se*. The third, the planet's *vehicular motion* as the incidental factor of its orbital motion is likewise constant for any given place in the planet's orbit, and becomes variant only as the planet's relation to its vehicle is changed by translocation therein. This is the sole cause of variation in the velocity of its orbital motion, and the only reason why its distance from the Sun also varies. All the planets of the Solar System move in orbits recognized as very nearly circular; and the conception of ellipsoid orbits was adopted to account for certain phenomena of their motion which have seemed otherwise inexplicable. But the hypothesis of elliptical planetary motion involves a greater mystery *per se* than that which it is meant to unravel. It has no other astronomic support than its supposed fitness to account for said phenomena (which, however, are consistent with circular orbits), except the annual variation (*a*) of the Sun's apparent diameter and (*b*) of its apparent motion. All that is positively signified by these visual facts is a greater nearness of the Earth to the Sun in one part of its orbit than in its opposite part, for which fact there is an accepable reason having no reference to the shape of the Earth's orbit. Whether or not this be an ellipse is inconsequential, because an ellipse is an effect and not a cause; it cannot be the *reason* why the Earth is nearer the Sun, or moves faster, at one time than another: but that has just been stated in terms which the reader will probably regard as worthy of elucidation; and here it is, inceptively in the diction of symbolic vision, to be compassed, not at a glance of eyes, but by rational study of the subjoined emblem of planetary motion.

Let the circle *A*, *B*, *C*, etc., represent the Earth's orbit; the alphabetic series indicating the direction in which the Earth is moving round the Sun, whose relative position is denoted by the asterisk, almost equidistant from *C* and *G*, and nearer to *E* than to *A*. Let x be the axis of vehicular motion common to the Sun, Earth and all the planets,—the axis of the rotating pericosm,—and the lines xy and xz radii of the circle described by the Sun's vehicular motion of which the curve line $y\,z$ is an arc. The line *A E* bisects the Earth's orbit equably, and so does the line

DIAGRAM III. Designed to elucidate the differential vehicular motion of the Earth and Sun, that of the Sun being equable, while that of the Earth is rendered variant by the Earth's orbital motion.



In studying this diagram, let the page be semi-reversed as in reading this prescription. Lest the prone attitude (a mistake of the drafter) of the literal symbols be misleading, let them be imagined upright.

C G; and the two by coincidence divide it into four equal parts by the consentaneous precincts represented by the lines *o s* and *y z*. The former of these lines with their virtual limitations are ideal; the latter signify the goals and ranges of certain motoric phenomena whose issues are climatic, being identified with the vicissitudes of the terrestrial year. These are germane to the regular revolution of the Earth about the Sun with but little variation of distance therefrom, together with its constant rotation and the unvarying inclination of its axis to the plane of its orbit. When the Earth in its annual circuit arrives at *s*, the vernal equinox occurs, which is also the beginning of Spring whose period terminates at *y*. Then and there advenes the summer solstice, or beginning of Summer, which coincides with the Earth's orbital motion to *o*, when and where the Autumnal equinox and beginning of Autumn occur, the period of the latter coinciding with the Earth's passage from *o* to *z*. At this point Winter begins whose goal is called the winter solstice and whose period tallies with the Earth's locomotion from *z* to *s*. The arc *y z* pertains to the Sun's vehicular motion: that part of it represented by *tv* being described by the Sun's vehicular motion in the same time in which the Earth's vehicular motion describes either the arc *lm* or the arc *rn*. Twice $tv = lm + rn$. The line *o s* is drawn between that part of the Earth's orbit which is appropriate to Spring and Summer and that which is appropriate to Autumn and Winter. The maximum of the Earth's orbital motion obtains at *C* and its minimum at G. The letter c is not quite useless as a symbol of the orbit's center.

With due inspection of the diagram it is obvious that the segments of the Earth's orbit $y\,A$ and $E\,z$ are analogous, and that the two intervening segments, Co and $s\,G$, are homologous; and with scrutiny it is further evident that any one of the unequal segments made by the lines $y\,z$ and os differs from the equal segments made by the lines $A\,E$ and $C\,G$ only by the addition thereto or subtraction therefrom of one or of two of the four small segments. The arc yo appropriate to Summer, contains one-fourth the orbit *plus* $y\,A$ and Co, whereas the arc from z to s, appropriate to Winter, contains only one-fourth the orbit *minus* Ez (the analogue of $y\,A$) and $s\,G$ (the homologue of Co). So the arc from s to y, appropriate to Spring, embraces one-fourth the orbit *plus* $s\,G$ and *minus* yA; while the opposite arc from o to z, appropriate to Autumn, embraces one-fourth the orbit *minus* Co but *plus* $E\,z$. And this diagramic view of the Earth's orbit is justified by the subjoined tabulation of conceptive divisions, which prove to be in strict accord with corresponding dates of astronomic observation.

I. Winter : 89·063185 days.

143,620,694·853649 — 1-4 the Earth's orbit.
525,128.600327 — Ez subtracted.
143,095,566·253322
1,623,862·545551 — $s\,G$ subtracted.
141,471,703·707771 Miles of motion.

II. Spring : 93.8855 days.

143,620,694·853646 — 1-4 the Earth's orbit.
543,531·4227 — *yA* subtracted.
143.077,163·430949
1,623,862·545551 — *sG* added.
144,701,025·9765 Miles of motion.

III. Summer : 93·5833 days.

143,620,694·853649 — 1-4 the Earth's orbit.
1,623·862·545551 — *Co* added.
145,244,557·4692
543,531·4227 — *yA* added.
145,788,088·8219 Miles of motion.

IV. Autumn: 89·724372 days.

143,620,694·853649—1-4 the Earth's orbit.
1,623,862·545551— *Co* subtracted.
141,996,832·308098
525,128·600327— *Ez* added.
142,521,930·908425 Miles of motion.

The general as well as special and distinctive accuracy of the four tables here presented is doubly verified by adding the respective duration of the four seasons, the sum of which tallies with the otherwise-ascertained length of the year; and also by adding the different *quanta* of the Earth's orbital motion contemporary therewith, the sum of which likewise tallies with the otherwise-ascertained compass of the Earth's orbit, to wit:

The Earth's Period.

Duration of Winter	89·063185	days.
“ “ Spring	92·8855	“
“ “ Summer	93·5833	“
“ “ Autumn	89·724372	“
“ “ The Year	365·256357	“

The Earth's Orbit.

Arc of Winter	141,471,703·707771	miles.
“ “ Spring	144,701,025·9765	“
“ “ Summer	145,788,088·8219	“
“ “ Autumn	142,521,960·908424	“
	574,482,779·414595	“

Now if we divide the *quantum* of the Earth's orbital motion during each season by the time in which it is accomplished as specified above, the quotient will indicate the mean velocity thereof as pertinent to each separately, thus:

Autumn and Winter.

142,521,960·908424 ÷ 89·724373 = 1588442 = 141,471,703·707771 ÷ 89·063185.

Summer and Spring.

145,788,088·8219 ÷ 93·5833 = 1557843 = 144,701,025·9765 ÷ 92·8855.

That is to say, the Earth's orbital motion during Winter divided by Winter's period is equal to the Earth's orbital motion during Autumn divided by Autumn's period; and the number of miles the Earth moves in Summer divided by the number of days that Summer lasts is equal to the number of miles the

Earth moves in Spring, divided by the number of days that Spring lasts. In other words, the Earth moves in its orbit during Autumn and Winter at the mean rate of 1588442 miles a day, and during Spring and Summer at the mean rate of 1557843 miles a day. These and kindred astronomic facts are made conspicuous by the following synopsis of their arithmetical congruity.

Autumn and Winter.

89·724372	} ×1588442 = {	142521960·908424	Arc *oz*
89·093185		141171703·707770	" *zs*
178787557	sum.	283993664·616194	sum.
·661187	difference.	2)1050257·200654	differ.
		525,128·600327	*ArcEz.*

Summer and Spring.

93·5833	} ×1557843 = {	145788088·8219	Arc *yz.*
92·8855		144701025·9765	" *s y.*
186·4688	sum.	290489114·7984	sum.
·6978	difference.	2)1087062·8454	difference.
		543,531·4227	Arc *y A.*

Spring and Winter.

92·8855	×1557843=	144701025·9765	
89·063185	×1588442=	141471703·707771	
181·948685	sum.	286172729·684271	sum.
3·822315	difference	3229322·268729	difference.
		18402·722373	added.
		2)3247725·091102	
		1,623,862·545551	Arc. *s G.*

Summer and Autumn.

93.5833 × 1557843 = 145788088·8219
89·724372 × 1588442 = 142521960·908424
183·307672 sum. 288310049·730324 sum.
3·858928 difference. 3266127·913476 difference.
18402·822373 subtracted.
2)3247725·091103
1623862·545551 Arc. *Co.*

A prominent feature of this tabulation is the fact that the Earth moves in its orbit 30,599 miles a day faster during Autumn and Winter than during Spring and Summer. It also appears that the difference between the quantum of the Earth's orbital motion during Summer and the quantum thereof during Autumn is 36,805 miles greater than the difference between the quantum thereof during Spring and the quantum thereof during Winter; and that the difference between the arc of the Earth's orbit traversed during Summer and the arc thereof traversed during Spring is 36,805 miles greater than the difference between the arc thereof traversed during Autumn and the arc thereof traversed during Winter; as—

3,266,127·913476 1,087,062·8454
3,229,322·26873 = 1,050,257·200654
36,805·644746 36,805·644746

Therefore half this duplicate number of miles (18,402·82+) is *added to* the difference between the Earth's motion in Spring and its motion in Winter, and *subtracted from* the difference between its motion in Summer and its motion in Autumn, in order to equalize the half of either as *sG* or *Co*, as denoted in the tabular synthesis, this feature of which is reproduced below.

$$\begin{array}{r@{\qquad}r} 3266127{\cdot}913476 & 3229322{\cdot}26873 \\ 18402{\cdot}822373 & 18402{\cdot}822373 \\ \hline 3247725{\cdot}091103 = & 2247725{\cdot}091103 \end{array}$$

This last duplicate number is equal to twice *Co* or twice *sG*, and measures the difference between the greatest and least distance of the Earth from the Sun. It is also equal to half the difference between that portion of the Earth's orbit appropriate to Summer and Spring, and that portion which is apprpriate to Autumn and Winter, as

$$\begin{array}{r} 290489114{\cdot}7974 \\ 283993664{\cdot}616194 \\ \hline 6495450{\cdot}181206 \div 2 = 3247725{\cdot}090603. \end{array}$$

The homologous arcs *Co* and *sG* being together equal to the difference between the greatest and least distance of the Earth from the Sun, either of them measures the Sun's permanent distance from the center of the Earth's orbit, as

3247725·090603 ÷ 2 = 1,623,862·5453 miles.

The Earth's mean distance from the Sun is found by dividing its orbit by twice *pi*, thus:

574482779·414595 ÷ 6·2832 = 91,431,560·258227.

To this quotient add *Co* or *sG*, that is *half the difference* between the greatest and least distance of the Earth from the Sun, *alias* the distance of the Sun from the center of the Earth's orbit (1623862 miles), and we have the Earth's apohelion = 93,055,422 miles; or substract the same therefrom and we have the Earth's perihelion =89,807,697 miles.

The annual quantum of the Earth's orbital motion is consecutively equal, while the velocity thereof is perpetually varying. The annual mean of its variation, found by subtracting its mean velocity during Spring and Summer from its mean velocity during Autumn and Winter, is 30,599 miles a day, making the yearly quantum of its variation 11,176,479 miles. This is the express increment of the Earth's orbital motion from *A* to *E*, and the express decrement thereof from *E* to *A*. Therefore half the Earth's orbit *plus* half the yearly quantum of its motoric variation, divided by half its orbital period, equals the maximun of its orbital motion; and half the Earth's orbit *minus* half the yearly quantum of its motoric variation, divided by half its orbital period, equals the minimum of its orbital motion, as shown below.

287241389·707297
5588239·6339215
295829629·4312185 ÷ 182·6281785 = 1603419·7556
Maximum per diem.

287241389·707297
5588239·6339215
281653150·0733755 ÷ 182·6281785 = 1542221·7556
Minimum per diem.

Now, half the sum of the maximum and minimum is the mean, which obtains semi-annually at *C* and *G*, and is measured thus:

1603419·7556
1542221·7556
3145641·5112 ÷ 2 = 1572820·7556 *Integral mean per diem.*

There is also another integral mean, which obtains with unequal interims at *o* and at *s*, and is identifiable with half the sum of the two fractional means appropriate to the unequal divisions of the Earth's orbit according to the apparent motion of the Sun, namely:

1588442 South-tropical mean.
1557843 North-tropical mean.
3146285 ÷ 2 = 1573142·5 *Equinoctial mean.*

As shown here and heretofore, the Earth moves in its orbit during Autumn and Winter at the mean rate of 15588442 miles a day, and during Spring and Summer 1557843 miles a day; which fractional averages of the Earth's orbital motion obtain, each respectively, in two analogous parts of its orbit, the north-tropical mean obtaining (about the first of May and last of July) midway of the arcs from *s* to *y* and from *y* to *o* (nearly at *H* and *B*), and the south-tropical (about the first of November and last of January) midway of the arcs from *o* to *z* and from *z* to *s* (nearly at *D* and *F*).

The equinoctial mean of the Earth's orbital motion differs from the semi-annual-integral by 321·5 miles, and from either tropical mean by 15,299·5 miles; yet the veritableness of either is tested by diverse modes of discovery. The third and fourth paragraphs of the foregoing tabulation are susceptible of variation in terms with equivalent results involving the congruity of the two integral means, as exemplified below.

$$\begin{array}{rcr}
183{\cdot}307672 & & \\
\underline{3{\cdot}858928} \times 1557843 & & 6011603{\cdot}972304 \\
179{\cdot}448744 \times 1573142{\cdot}5 & = & \underline{282298445{\cdot}75802} \\
 & & 288{,}310{,}049{\cdot}730324 \\
181{\cdot}948685 & & \\
\underline{3{\cdot}822315} \times 1557843 & = & 5954566.666545 \\
178{\cdot}126370 \times 1573142{\cdot}5 & = & \underline{280218163{\cdot}017725} \\
 & & 286{,}172{,}729{\cdot}684270 \\
357{\cdot}575114 \times 1573142{\cdot}5 & = & 562516608{\cdot}775745 \\
\underline{7{\cdot}681243 \times 1557843} & = & \underline{11{,}966{,}170{\cdot}638849} \\
365{\cdot}256357 & & 574{,}482{,}779{\cdot}414594
\end{array}$$

$$474{,}482{,}779{\cdot}414594 \div 365{\cdot}256357 = 1572820{\cdot}7556.$$

Dividing the Earth's orbit by its orbital period produces its mean velocity *per diem*. For though a planet moves faster at one time than another, its annual quantum is neither more nor less than the measure of its orbit.

The difference between the north and the south tropical means of the Earth's orbital motion is precisely the same as that between the semi-annual integral and either the maximum or the minimum thereof, to wit:

$$\begin{array}{rrr}
1588442 & 1603419{\cdot}7556 & 1572820{\cdot}7556 \\
\underline{1557843} & \underline{1572820{\cdot}7556} & \underline{1542221{\cdot}7556} \\
30{,}599 = & 30.599 \quad = & 30{\cdot}599
\end{array}$$

Therefore $186{\cdot}4688 \times 30.599 = 5705758{\cdot}8112$ miles, measures the increase of the Earth's orbital motion from the autumnal equinox to the winter solstice and the decrease thereof from the winter solstice to the vernal equinox; and 178·787557×30,599=5470720·456643 miles, measures the decrease of the Earth's orbital motion from the vernal equinox to the summer solstice and the increase thereof from the summer solstice to the autumnal equinox. Accordingly, if the former of these products be added to the yearly quantum of the Earth's orbital motion and the sum be divided by its orbital period, the quotient is the mean velocity of the Earth's orbital motion south of the equinoxes; and if the latter of said products be subtracted from the measure of the Earth's orbit and the remainder be divided by the number of days in the year, the quotient is the mean daily velocity of the Earth's orbital motion north of the equinoxes, thus:

574,482,779·414594
5,705,758·8112

580,188,538·225794 ÷ 365·256357 = 1588442

574,482,779·414594
5,470,720·346643

560,012,059·067951 ÷ 365·256357 = 1557843

So if to half the Earth's orbit we add the difference between the greatest and least distance of the Earth from the Sun and divide the sum by the duration of Spring and Summer, the quotient is the mean velocity of the Earth's orbital motion north of the equinoxes; whereas if from half the Earth's orbit we subtract the difference between the Earth's greatest and least distance from the Sun and divide the remainder by the duration of Autumn and Winter, the quotient is the mean velocity of the Earth's orbital motion south of the equinoxes, to wit:

$$\begin{array}{r l}
287241389{\cdot}707297 & \\
3247725{\cdot}091103 & \\
\hline
290{,}489{,}114{\cdot}7984 & \div\ 186{\cdot}4688 = 1557843 \\
287241389{\cdot}707297 & \\
3247725{\cdot}091103 & \\
\hline
283{,}993{,}664{\cdot}616194 & \div\ 178{\cdot}787557 = 1588442
\end{array}$$

It is a fact, however, made patent by the foregoing tabular view, that the issues here presented are to be reached most directly by dividing the Earth's orbital motion either north or south of the equinoxes by the days of its accomplishment as tabulated. That this method applies only to one coupling of the seasons, that which accords with the equinoctial division of the Earth's orbit, signifies the subordination of the Earth's orbital motion to a dynamic principle whose mathematical insignia seem to have been generally ignored. It is long since the students of astronomy were first told that the planets of the Solar System are correlated in geometric proportion, as to their orbits and orbital periods; but I find no mention of the kindred fact that certain arcs of the Earth's orbit, as well as corresponding portions of the terrestrial year, are correlated in arithmetical proportion. I am disposed to make something of this fact, as it implies the causative agency of *some* universal principle to which both classes of planetary phenomena are alike subject, and which I expect to identify with the rotation of the physical world. But, to this end, demonstration of the alleged fact is first in order, which I proceed at once to realize analytically.

Proposition I. The temporal quanta of the four seasonal divisions of the terrestrial year are correlated in arithmetical proportion according to four different specifications, which are stated below as if occurring by rational consecution.

1. The ratio of the difference between the duration of Summer and Spring to the duration of Autumn and Winter is equal to the ratio of the difference between the duration of Summer and Autumn to the duration of Winter and Spring. In other words, as the difference between the duration of Autumn and that of Winter to the difference between the duration of Summer and that of Spring, so is the difference between the duration of Spring and that of Winter to the difference between the duration of Summer and that of Autumn, as demonstrated thus:

·661187 : ·6978 : : 3·822315 : 3.858928
·661187 3·822315
·036613 = ·035613

2. As the duration of Summer *minus* ·036613 of a day to the duration of Spring, so is the duration of Autumn to the duration of Winter. Thus:

93·5833
·036613
93.546687 : 92·8855 : : 89·724372 : 80·063185
92 8855 89·063185
·661187 = ·661187

3. As the duration of Summer *minus* ·036613 of a day to the duration of Autumn, so is the duration of Spring to the duration of Winter. Thus:

$$\begin{array}{lcl}
93.5833 & & \\
\underline{\cdot036613} & & \\
93\cdot546687 \ : & 89\cdot724372 \ : \ : & 92\cdot8855 : 89\cdot063185 \\
\underline{89\cdot764372} & & \underline{89.063185} \\
3\cdot822312 & = & 3\cdot822315
\end{array}$$

4. As the duration of Spring and Summer to the duration of Summer and Autumn, so is the duration of Winter and Spring to the duration of Autumn and Winter. Thus:

$$\begin{array}{lrcl}
186\cdot4688 : 183\cdot307672 : : & 181\cdot948685 & : & 178\cdot787557 \\
 & \underline{183\cdot307672} & & \underline{186.4688} \\
 & 365\cdot256357 & = & 365\cdot256357
\end{array}$$

Proposition II. The differential arcs of the Earth's orbit appropriate to the four seasons of the year, as well as the motoric quanta tallying therewith, are correlated in arithmetical proportion, as specified below.

1. The ratio of the Earth's orbital motion during Summer to that which obtains during Autumn is 36,805 miles greater than the ratio of that which obtains during Spring to that which obtains during Winter; and the same proportion is predicable of the four divisions of the Earth's orbit appropriate to the seasonal portions of the year. Also, the ratio of the Earth's orbital motion during Summer to that which obtains during Spring is 36,805 miles greater than the ratio of that which obtains during Autumn to that which obtains during Winter. In other terms,

as the difference of the Earth's orbital motion in Summer from that which obtains in Autumn to the difference thereof in Spring from that which obtains in Winter, so is the difference of that which obtains in Summer from that which obtains in Spring to the difference thereof in Autumn from that which obtains in Winter, to wit:

3266127 : 3229322 : : 1087062 : 1050257
3220322 1050257
36,805 = 36,805

2. As the arc of the Earth's orbit appropriate to Summer *minus* 36,805 miles is to the arc thereof appropriate to Spring, so is the arc thereof appropriate to Autumn to the arc thereof appropriate to Winter, to wit:

145788088
36805
145751283 : 144701025 : : 142521960 : 141471703
144701025 141471703
1050258 = 1050257

3. As the arc of the Earth's orbit traversed in Summer and Spring to the arc thereof traversed in Summer and Autumn, so is the arc thereof traversed in Winter and Spring to the arc thereof traversed in Autumn and Winter, to wit:

290489114 : 288310049 : : 286172729 : 283993664
283993664 286172729
574482778=574482778

4. As the quantum of the Earth's orbital motion during Summer to the quantum thereof during

Spring, so is the quantum thereof during Autumn *plus* 36,805 miles to the quantum thereof during Winter, to wit:

142521960
36805
145788088 : 144701025 : : 142558765 : 141471703
144701025 141471703
1087063 1087063

5. As the quantum of the Earth's orbital motion during Summer, *minus* 18,403 miles, to its quantum during Autumn, so is its quantum during Spring, *plus* 18,403 miles, to its quantum during Winter, to wit:

145788088 144701025
18403 18403
145769685 : 142521960 : : 144719428 : 141471703
142521960 141471703
3247725 = 3247725

Proposition III. The fractional means of the Earth's orbital motion north and south of the equinoxes, as well as the two intergral means thereof, are correlated in arithmetical proportion, as specified below.

1. As the maximum of the Earth's orbital motion to its mean, so is its mean to its minimum. Thus:

1603419 : 1572820 : : 1572820 : 1542221
1572820 1542221
30,599 = 30,599

2. As the south-tropical mean of the Earth's orbital motion to the equinoctial mean thereof, so is the

equinoctial mean thereof to its north-tropical mean. Thus:

$$\begin{array}{lcl} 1588442 : 1573142\cdot5 & :: & 1573142\cdot5 : 1557843 \\ \underline{1573142\cdot5} & & \underline{1557843} \\ 15{,}299\cdot5 & = & 15{,}299\cdot5 \end{array}$$

3. The ratio of the intergral to the south-tropical mean of the Earth's orbital motion is equal to the ratio of its minimum to its north-tropical mean. Thus:

$$\begin{array}{lcl} 1572820 : 1583442 & :: & 1542221 : 1557843 \\ \underline{1572820} & & \underline{1542221} \\ 15622 & = & 15622 \end{array}$$

4. The ratio of the maximum to the south-tropical mean of the Earth's orbital motion is 643 miles less than the ratio of the north-tropical mean to the minimum thereof. Thus:

$$\begin{array}{lcl} 1588442 & & \\ \underline{643} & & \\ 1603420 : 1587799 & :: & 1557843 : 1542222 \\ \underline{1687799} & & \underline{1542222} \\ 15{,}621 & = & 15{,}621 \end{array}$$

5. The quantum 643 miles being twice the difference between the semi orbital and the equinoctial mean of the Earth's orbital motion, the ratio of the south-tropical to the equinoctial mean thereof is 321·5 miles greater than the ratio of the north-tropical to the minimum thereof. Thus:

$$\begin{array}{lcl} & & 1557843 \\ & & \underline{321\cdot5} \\ 1588442 : 1573142\cdot5 & :: & 1557521\cdot5 : 1542222 \\ \underline{1573142\ 5} & & \underline{1542223\cdot} \\ 15{,}299\ 5 & = & 15{,}299\cdot5 \end{array}$$

Now, in view of the foregoing array of arithmetical proportions and other features of the Earth's orbital motion, the rational-minded reader is incited to inquiry as to how they are to be accounted for. I repeat that this qnestion has never been answered scientifically; for it is absurd to impute any class of the said motoric phenomena to the inert form of the Earth's orbit, as has been done ever since the days of Kepler. It may be, however, that Kepler is not responsible for the turn which his thought has taken in later times. I know nothing of his opinions except by hearsay; but his "second law" so-called, as represented by Sir John Herschel, was essentially different from its statement by many of his would-be disciples, as given in the standard text-books of astronomy, wherein it is always illustrated by an ellipse with the Sun in one of its foci. But in Herschel's *Outlines of Astronomy* the very converse of that is presented, namely, an ellipse with the Earth in one of its foci, and the Sun traversing its contour. Here is an extract from Herschel's interpretation of Kepler's conception of ellipticity in the orbital motion of planets:

"Let a line be always supposed to connect the Sun, supposed in motion, with the Earth, supposed at rest; then, as the Sun moves along its ellipse, this line (which is called in astronomy the *radius vector*) will *discribe* or *sweep over* that portion of the whole *area* or *surface* of the ellipse which is included between its consecutive positions, and the motion of the Sun will be such that *equal areas are* thus *swept over* by the revolving radius vector in *equal times*, in whatever part of the circumference of the ellipse the Sun may be moving."

Who doubts that Sir John Herschel was competent to speak for Kepler? According to the cited authentic statement, it was not the Earth's orbit, but the virtual orbit of the Sun, that Kepler regarded as elliptical. And so it *is*, relatively to the Earth "supposed at rest," in one of the foci of the Sun's apparent orbit; but this does not warrant the inference that the real orbit of the Earth is also elliptical. Consider the difference of noumenal from phenomenal, as exemplified by the apparent diurnal motion of the Sun—how unlike the Sun's daily stride of the welkin is the Earth's semi-rotation. However analogous we may fancy the path which the Earth describes about the Sun to that which the Sun only seems to describe about the Earth, it is demonstrable that the two are not homologous; and this is practical in two ways.

1. That the Earth's orbit is a perfect circle is proved in this way: Supposing it to be elliptical, its major axis must lie between its apohelion and perihelion points. These two points are opposite and distant from each other by the sum of the Earth's greatest and least distance from the Sun, namely:

Apohelion 93,055,422·6 Miles.
Perihelion 89,807,697·5 "
182,863,120 "

But this purported major-axis is in fact the mean diameter, since the whole orbit is otherwise found to be the product of $182,863,120 \times 3·146 = 574,482,779$ miles. Therefore the mean distance of the Earth from the Sun is its constant distance from the center of its orbit, which thus proves to be a circle in no degree elliptical.

2. The circular form of the Earth's orbit is ascertained by inference from the fact that the Earth itself moves fastest when nearest the Sun and slowest when most distant from the Sun; which proves that the Earth's solar gravity is greatest, just when and where the velocity of its orbital motion (and so its centrifugal bent) is greatest, and *vice versa;* so that the two factors of its curvature are certainly equal in these two opposite points thereof, and unless they become unequal between the Earth's perihelion and apohelion, they must be equipollent throughout the whole orbit. Beyond a further question, however, it is otherwise ascertained that the Earth's solar gravity increases gradually from perihelion to apohelion; while the velocity of the Earth's orbital motion (and consequently the Earth's centrifugal bent) is *as* gradually accelerated from its maximum to its minimum. This certifies that the two factors of curvature in the case are perpetually equipollent, so that the Earth's orbit never varies from a circle.

So much of negative argument on the propounded question is relevant mainly because of the unwared deference to old authority, by the popular mind, which often blurs the consciousness of one's own ability to discover truth. But apart from that, the question admits of a positive answer the validity of which is quite within the scope of ordinary thinking. This is identified with the rationale of planetary motion in general, whereof the Earth's orbital motion is but a species. Therefore the examples of arithmetical proportion presented above are to be accounted for as depending upon the same ulterior principle as that according to which the orbits and orbital periods of the whole Solar System are correlated in geometrical proportion.

It is conceptively evident that the quaternary divisions of the terrestrial year and of the Earth's orbit coincident therewith would be commensurate, the Earth traversing a quadrant of the latter during each season, if its orbital motion were the resultant of its projectile impetus alone: for this is unvarying *per se*, as is proved by the serial parity of every planet's cycle; the four seasons of this, with all the issues of their thermal variations, being due to the unvarying inclination of the planet's equator to the plane of its orbit; its orbital motion also being subject to an annual routine of variations merely in velocity.

An analytic exposition of the genesis and continuous support of a planet's orbital motion having been given in chapters VI. and VII., it only remains to elucidate the principle of its variation. As to this, one conceptive reason only is adducible as the physical cause of the Earth's varying distance from the Sun, making its orbit relatively to that virtually elliptical; and that is, the perpetual variation of the Earth's vehicular motion, which, in effect of its orbital motion, is alternately greater and less than that of the Sun—greater from the beginning of Summer to the end of Autumn and less from the beginning of Winter to the end of Spring.

To see the truth of this statement, it must be borne in mind that the quantum of the Earth's vehicular motion *in toto* of its orbital cycle is just equal to that of the Sun, whose vehicular motion is unvarying, whereas that of the Earth (by transposition in its orbit) alternately exceeds and is exceeded by that of the Sun by 3,247,725 miles *per annum.* The issues of this predicament are relevantly symbolized by diagram III., inceptively by the type of the Sun's *positus* slightly apart from the center of the Earth's orbit, and complementively by the correlative purport of other designations. When the Earth is at *y* or *z* the the velocity of its vehicular motion coincides with that of the Sun, because they are equidistant from *x*, the axis of the world's rotation; but at *C*, the Earth's greatest distance from *x*, its vehicular motion exceeds that of the Sun in the ratio of the conceptive arc *lm* to the arc *tv*, which is perceptibly less than *lm*; whereas at *G*, the Earth's least distance from *x*, its vehicular motion is less than that of the Sun in the ratio of the conceptive arc *rn* to the arc *tv*, which is perceptibly greater than *rn*: *tv* being the mean proportional between *lm* and *rn*; that is to say, the ratio of *lm* to *tv* is equal to the ratio of *tv* to *rn*, in correspondence with the proportion given above, namely, as is the maximum of the Earth's orbital motion to its mean, so is its mean to its minimum. We know not, and may not be able to ascertain, the measure of the Earth and Sun's vehicular motion *in toto*; nor is it needful to the aim of this chapter. Enough to know that that of the Sun is unvarying, and that that of the Earth, though constantly variant, is annually equal to that of the Sun. Let this be denoted by the letter x, and we have this proportion:

$$x \times 3{,}247{,}725 : x :: x : x - 3{,}247{,}725.$$

That is to say, the Earth's vehicular motion (and so its orbital motion) from *B* to *D* is as much greater than that of the Sun as it is less from *F* to *H*.

So the arc *tv* typifies the mean of the Earth's vehicular motion as being coincident with that of the Sun, while the conceptive arcs *lm* and *rn* typify the extremes of its semi-annual variation, the trend of which, nevertheless, is always parallel to the arc of the Sun's vehicular motion. But the trend of vehicular motion is nearly perpendicular to that of the Earth's orbital motion in the two opposite quadrants of its orbit *H B* and *D F*, and nearly parallel therewith only in the two intervening quadrants *B D* and *F H*, the twain concurring from *B* to *D*, but conflicting from *F* to *H*.

Thus the orbital translation of the Earth occasions a semi-annual increase of its vehicular motion from *G* to *C*, and an equal decrease from *C* to *G*; and this increment is added to the Earth's orbital motion only when and in proportion as the varying trend of the latter comes to accord with the unvarying trend of the former, which is mainly from *B* to *D*; and the same is subtracted from the Earth's orbital motion when and in proportion as this comes to conflict with the Earth's vehicular motion, as it does mainly from

F to *H*. In this way, from *B* to *D* the Earth's orbital motion is actually increased by composition with the planet's vehicular motion, though virtually diminished by competition with the Sun's vehicular motion, which is less than the Earth's by one-fourth of *tv*. Conversely, from *F* to *H*, the Earth's orbital motion, though actually diminished by encountering the planet's vehicular motion, is virtually increased by competition with that of the Sun which, in this case, exceeds the Earth's by one-fourth of *tv*. In other terms, from *B* to *D* the Earth's orbital motion is actually increased by the motoric value of *lm* and virtually diminished by the motoric value of *tv*; but from *F* to *H* it is actually diminished by the motoric value of *rn* and virtually increased by the motoric value of *tv*. So the Earth's orbital motion is equally promoted in the inmost and outmost quadrants of its orbit, being actually increased in the outmost and virtually increased in the inmost one-fourth of *tv* respectively; the distinguishing epithets actual and virtual signifying that its increment from *B* to *D* is active and fraught with momentum, whereas that from *F* to *H* is relative and devoid of momentum, being identified with the greater vehicular motion of the Sun than of the Earth. But this is as relevant to the thrift of planetary motion as that. In the outmost quadrant of the Earth's orbit, the variant part of the planet's vehicular motion concurs with the orbital motion, from which it is divorced in the next quadrant. But the momentum of its increment is conserved by the Earth from *D* to *F*, the trend of the planet's vehicular motion approximating to coincidence with that of its solar gravity which is thus strengthened and rendered equipollent with its centrifugal bent, this also being simultaneously strengthened in accord with the increasing velocity of the Earth's orbital motion. Moreover, from *D* to *F* the Earth's vehicular motion is rapidly diminished while that of the Sun remains *in statu quo*, this excelling that from *F* to *H* by one-fourth of *tv*. For while the Earth is moving from *F* to *H* it retrogrades by its own vehicular motion relatively to that of the Sun in the ratio of *rn* to *tv*, or as 3 to 4, that is three-fourths of *tv*. Consequently, when it arrives at *A*, the Earth is one-fourth of *tv* further from the Sun than at *E*; *tv* signifying, according to the symbolic terms of the diagram, four times the difference between the greatest and least distance of the Earth from the Sun, and one-fourth of *tv*, as the unit of measurement stated above, is otherwise found to be 3,247,725 miles.

Thus the reason why the Earth is so much further from the Sun at *A* than at *E* is deduced from the fact that in the time of passing from *E* to *A* the Earth's vehicular motion is in aggregate 3,247,725 miles less than that of the Sun; whereas, in the time of passing from *A* to *E* its vehicular motion amounts to 3,247,725 miles more than that of the Sun: and, since the arc of the Earth's vehicular motion, is parallel to the arc of the Sun's vehicular motion, which is diametric to the Earth's orbital motion in two quadrants of its orbit, the latter is increased during the Earth's transit from *A* to *E* and diminished during its transit from *E* to *A* in the ratio of a circle to its diameter—by 3,247,725 × 3·1416 = 10,203,052·86 miles. This product is 973,427 miles less than the annual variation of the Earth's orbital motion, elsewhere shown to be 11,176,479 miles. But the discrepancy is merely apparent and readily accounted for as being due to the varying trend of the Earth's orbital motion in relation to the arc of its vehicular motion, the trend of which is constant, the former changing gradually in relation to the latter from parallel to transverse and from transverse to parallel in successive quadrants of the orbit, from *G* to *A* and from *A* to *C*, thence to *E* and thence to *G*. Though there seems to be no feasible method for calculating the resultant of the said motoric predicament, or if there be it must be intricate, it is remarkable that its observed quantum is exactly measured by the sum of four kindred attributes of the Earth's orbital motion, to wit:

(*a*) The difference between the increment of the Earth's orbital motion (by accession of its vehicular motion) from the mean to the maximum thereof and the decrement of the same (by derogation of its vehicular motion) from the mean to the minimum thereof = 235038 miles, *alias* 5705758—5470720, as explained in a former paragraph.

(*b*) The difference between the ratio of the Earth's orbital motion in Summer to that which obtains in Autumn and the ratio of that which obtains in

Spring to that which obtains in Winter = 36,805 miles.

(*c*) The difference between the ratio of the Earth's orbital motion in Summer to that which obtains in Spring and the ratio of that which obtains in Autumn to that which obtains in Winter = 36,805 miles.

(*d*) The tangential divergence of the arc of the Sun's vehicular motion from the diameter of the Earth's orbit with which it most nearly coincides = 1204 miles. That is to say, the arc $y\ c$ or $c\ z$ of the Sun's vehicular motion, to which that of the Earth is synodically equal, is 1204 miles longer than the diameter of the Earth's orbit.

Now $a+b+c+d = 309,852$ miles, and this sum added to the difference between the Earth's greatest and least distance from the Sun (3,247,725 miles) amounts to 3,557,575·72 miles, which being multiplied by 3·1416 produces 11,176,479·89 miles, the semi-annual quantum of the Earth's variant orbital motion, whereof 973,427, equal to 309,852 × 3·1416, is *quasi* in the sense just stated, the reality of which is evinced, as to each quantum respectively, by the mode of its discovery.

The space-value of *a* is discoverable in two ways: either as $7·681243 \times 30,599 = 235,038$ miles; or as $5705758 - 5470720 = 235,038$ miles.

The space-value of *b*, as well as of *c*, is found by subtraction as directed by the descriptive terms of either, thus:

$$\begin{array}{r} 1087062 \\ \underline{1050257} \\ 36{,}805 \text{ miles.} \end{array} \qquad \begin{array}{r} 3266127 \\ \underline{3229322} \\ 36{,}805 \text{ miles.} \end{array}$$

In calculating the quantum denoted by d, two hypotheses are relevant: one, that it depends on the greater orbital motion of the Earth from C to o and from s to G than obtains in the northerly homologues of these two arcs conjointly. Therefore—

365 : 178 : : 7·68 : 3·745 ; and $3{\cdot}745 \times 321{\cdot}5 = 1204$.

But this is not causative; it is merely an incidental gauge of d, with no allusion to its putative factor, which, however, is suggested by the similarity of the terrestrial and solar arcs of vehicular motion, and made probable by their periodic parity as well as unity in two points of the Earth's orbit. Finally, that the import and genesis of d are correctly stated above is confirmed by identification of its elements as below.

It is evident that the chord of the arc $y\,c\,z$ is less than $A\,E$, the diameter of the Earth's orbit, and that this also is less than the arc $y\,c\,z$ which over-spans two radii. The mean of $y\,A + E\,z =$ the altitude of the arc $y\,c\,z$ from its chord: and so the arc $y\,c\,z$ is nearly equal to twice the square root of the square of half its chord *plus* the square of its altitude.

The subjoined mathematical process involves the assumption that the chord of the arc $y\,c\,z$ is 1918 miles less than the allied diameter of the Earth's orbit; from which it follows that the arc of the Sun's vehicular motion traversing the Earth's orbit is 1204 miles greater than the orbit's diameter.

$543531{\cdot}6\ y\ A$

$\underline{525128{\cdot}5\ E\ z}$

$1068660 \div 2 = 534330$ altitude of arc $y\ c\ z$.

$91{,}431{,}560 - 959 = 91{,}430{,}601$ half the chord of $y\ c\ z$.

$(91430601)^2 = 8359554799221201$

$\underline{(534330)^2 = 285508548900}$

$\sqrt{8359840307770101} = 91432162\ y\ c$.

$91432162 - 91431560 = 602 = y\ c - A\ c$.

$\cdot 602 \times 2 = (d)\ 1204 = y\ c\ z - A\ E$.

The ten questions propounded at the beginning of this chapter are now answered. Though my treatment of the subject which embraces them is not exhaustive, I trust it leaves no room for query as to why the Sun is not exactly in the center of the Earth's orbit, though this is a perfect circle; why the four seasons of our year are not of equal duration, or why the Earth's orbit is unequally divided thereby; and why both these and those differentiations are nevertheless correlatively proportional. Conceivably beyond a reasonable doubt, these and all the elements of the Earth's orbital motion are germane to one and the same dynamic principle, that of the coëtaneous but discrepant vehicular motion of the Earth and Sun, while *that,—the hitherto-ignored fact of vehicular motion itself* as pertaining to the whole material parapherna of Nature,—is indubitably accounted for by postulating the world's axial rotation. For, if the Pericosmic Theory is true, all the known rudiments of the Earth's orbital motion are cognizable as natural sequences of physical necessity.

CHAPTER IX.

THE PHYSICAL CAUSE OF PLANETARY ROTATION.

The Earth's original circumference was 1,696,922 miles, and its equatorial diameter accordingly 540,146 miles; but when it gave birth to the Moon its dimensions tallied very nearly with those of the Moon's terrestrial orbit whose circumference is 1,500,385 and diameter 477,586 miles. The Moon itself at birth was 54,916 miles in circumference and 17,480 miles in diameter. The circumference of the Earth's nebular parent at the epoch of its terrestrial parturition was that of the Earth's extant orbit *plus* the newborn planet's circumference. In the event of the prospective Earth's disseverance therefrom in the form of a revolving ring, the momentum of its nebular parentage became the propelling force of its orbital motion, which was 1572820·7556 miles a day, the precise measure of its nebular parent's rotary motion. Subsequently, when the ante-terrestrial ring was conglobated, the new-born Earth began to rotate 54,916 miles a day, making a complete rotation once in 30·9 days and 11·82 rotations in a year. But at the later epoch of the Moon's birth, which was preceded by a long period during which the Earth's volume was condensed by gravity from 540,146 to 477,586 miles in diameter, the period of the Earth's rotation had been shortened to 27·321 days and the number of its rotations increased to 13·369 in a year. Here the question emerges, Why did it rotate at all? — What is the physical cause of a planet's rotation, and by what principle is the rate of its rotary motion determined? I have explained elsewhere how nebular rotation is generated, as the primordial and perpetual factor of planetary evolution, but planetary rotation is of quite another predicament.

Sequential to the dual agency whereby nebular rotation is generated and cosmic evolution inagurated, a planet's rotation is the product of three motoric factors which obtain consecutively in effect of the planet's orbital motion. Two of these motive powers are collocated in opposite points of the planet's equator and trend antithetically, yet are functionally co-ordinate and mutually relevant. They are

1. *The diametric difference of the planet's vehicular motion*, whose rotatific agency is merely potential till seconded by its junior colleague;

2. *The diametric difference of the planet's orbital motion*, whose function, notwithstanding its subsequent inauguration, is virtually cöincident with that of its antecedent.

These two coëfficients of a planet's rotary motion ensue directly (in a manner as nearly cöincident as is imputable to the correlation of antecedent and consequent) from its orbital motion, and by virtual cöalition constitute the prime impetus to its semi-rotation. To consummate its integral rotation requires a third factor thereof, to wit:

3. *The consecutive transverse and converse momentum of the planet's semi-rotative impetus*, the genesis of which depends upon the plurality of the ratio of the planet's rotary period to its orbital period. If this ratio be but a unit the complemental factor of its rotation is not inaugurated.

Antecedent to these three motive agents of a planet's rotary motion is its orbital motion, without which none of them can obtain; and its orbital motion is the product of two anterior factors, namely: its centripetal (now solar) gravity, and the momentum of the rotary motion of its nebular antecedent. Both these factors are essential to the continuous motion of a planet in its orbit; for, though its orbital motion seems to be due only to the momentum of its nebular antecedent, it is certain that the bent of that is tangential to the planet's orbit, so that without the perpetual constraint of procentric gravity, or gravity toward the center of the new-born planet's nebular parent, it would move only in a straight line and thus desert its orbit. But procentric gravity has no tendency to beget planetary rotation.

It may be plausibly imagined that the diametric difference of a new-born planet's procentric gravity, culminating as it does at the vertex of the planet's inner hemisphere, may be the prime incentive to its rotation. But the notion is impugned by the behavior of projectiles near the earth's surface, whose terrestrial gravity is relatively the same as that of the Moon. When a ball is thrown horizontally with care not to twirl it by the hand, it shows no tendency to rotate before contacting with the ground. Its non-rotation cannot be due to atmospheric friction, since this, being greater on the lower than on the upper side of the missile (because of the unequal density of its medium), is in accord with the said hypothetic function of procentric gravity, and so should help rather than hinder its rotation. But the question, though speculative, is answered inductively. In fact, when the subject is thoroughly penetrated it becomes evident that procentric gravity, by its equal pertinence to the anterior and posterior sides of a planet, tends only to obstruct its rotation.

A planet in traversing its orbit describes three homocentric circles, the largest of which is germane to the locomotion of the transient vertex of its outer hemisphere (that which is farthest from the centre of its orbit), the smallest germane to the locomotion of the vertex of its inner hemisphere, and one intermediate to these two which is germane to the locomotion of the planet's rotary axis. The diameter of the largest of these three circles exceeds that of the least by twice the diameter of the planet, the mean of their difference being represented by the intermediate circle, which differs from either of its allies by the quantum of the planet's circumference. If the axial orbit of a planet be designated by the letter

a and its difference from either of its said homologues by the letter b, then $a+b$ will represent the outer and $a-b$ the inner margin of the planet's orbital circuit.

The number of miles traversed daily by the Moon's axis in its terrestial orbit is 54,916, which is lunar-rotary as well as lunar-suborbital; the motoric quantum of the Moon's rotary cycle being just equal to that of its daily suborbital motion, and also equal to the difference of its axial orbit from either margin of its conceptive terrestrial circuit. The product of a, lunar-rotary, into 27·321, the number of days in a lunation, is 1500385, which is a, lunar-suborbital. Then $a+b$ lunar-suborbital is 1555302, and $a-b$, lunar-suborbital, is 1445468. Now b, lunar-suborbital, is just equal to its terrestrial antecedent, that is b, terrestrial-rotary, 54,916 miles, the daily rotary motion of the new-born Earth and consequently the daily suborbital motion of the Moon. In this order of planetary predicaments the following are worthy of special designation.

1. *Terrestrial-orbital.*

(*a*) The Earth's orbit divided by (*b*) its orbital motion is equal to 574,482,779·414594 ÷ 1,572,820·7556 = 365·256357 days.

2. *Terrestrial-inchoate-rotary.*

(*a*) The Earth's primal equator divided by (*b*) its prime rotary motion is equal to 1696922÷54916= 30·9 days.

3. *Terrestrial-bimotoric.*

(*a*) The Earth's orbital motion divided by (*b*) its primal rotary motion is equal to 1572820·7556 ÷ 54916·9343 = 28·64, ratio in miles.

4. *Lunar-suborbital.*

(*a*) The Moon's suborbit divided by (*b*) its suborbital motion is equal to 1500385 ÷ 54916 = 27·321 days of a lunation.

5. *Lunar-quasi-rotary.*

(*a*) The Moon's equator divided by (*b*) its prime rotary motion is equal to 54916·9343 ÷ 2010·0631 = 27·321 days.

6. *Terrestrial-cyclic.*

(*a*) The Earth's orbital period divided by (*b*) its primal rotary period is equal to 11·820594 primal rotations in a year.

7. *Lunar-cyclic.*

(*a*) The terrestrial year divided by (*b*) the lunar cycle is equal to 365·256357 ÷ 27·321 = 13·369 annual lunations.

It now appears that lunar rotation is related to terrestrial rotation as a species to a genus, so that both are amenable to one and the same principle. It is discovered at length that the rotary motion of a planet is proportional to its original diameter (modifiable virtually by another attribute yet to be discussed), and that the Earth turns on its axis faster than the Moon for the same reason for which Jupiter rotates more rapidly than the Earth. More definitely, it has been duly ascertained that the Earth rotates 27·321 times as often as the Moon because the diametric difference of the Earth's orbital and vehicular motions is 27·321 times as great as that of those of the Moon.

There are diverse ways of learning the fact that the Moon's period of rotation, as well as that of its suborbital motion, is precisely equal to that of the Earth's rotation when the Moon was born; and furthermore, that the difference of their rotary motion at the same epoch was proportional to the virtual difference of their original diameters, which, acccording to the foregoing tables, were nominally disproportional. But the diameter of the Earth's equator at the Moon's nativity was equal to that of the Moon's terrestrial orbit; whence ensued the equality of a lunation to the Earth's synchronal rotation. The Earth's circumference at the same date—and so the spacial measure of its rotative cycle —was equal to 27·321 times the quantum of its daily rotary motion; and this same proportion obtained also between the Moon's circumference, the spacial compass of a lunation, and *its* daily rotary motion. Hence the tardiness of lunar as compared with terrestrial rotation. The reason is not alone in that the Moon was born of the Earth and thence inherited its planetary aptitudes; it is mainly in the fact expressed by dividing the diameter of the lunar-parturient Earth by that of the new-born Moon, thus: 477,586 ÷17,480=27·321. Then, by making this quotient the divisor of the number of miles traversed daily by the new-born Earth,—a journey still commemorated by that of the Moon in its terrestrial orbit,—we find as the resulting quotient the daily quantum of the Moon's primal rotary motion, to wit: 54916÷27·321 =2010. But since its birth the Moon's volume has been condensed by gravitation of its substance till at the time of its exterior solidification its diameter was, as now, only 2153 miles, instead of 17,480 miles as at first. Therefore, dividing this by that (17480÷2153 =8·1189) and making the resulting quotient the divisor of the new-born Moon's daily rotary motion (2010·0631÷8·1189), we obtain what is otherwise found to be the daily extant rotary motion of the Moon's equatorial surface, to wit: 247·57 miles *per diem.* For 2153×3·1416=6763·8648, and 6763·8648 ÷27·321==247·57.

As said above, the integral and actual rotation of a planet depends on the plurality of the ratio of its orbital to its rotary period; but, as appears in the foregoing tabulation, the ratio of the Moon's suborbital period to its quasi-rotary period is a unit. That is to say, the quotient of *a* divided by *b* in the lunar-suborbital predicament is just equal to the quotient of *a* divided by *b* in the lunar-quasi-rotary predicament. Thus, 27·321÷27·321=1. Quite otherwise, in plying the same process to the elements of terrestial rotation the result is found to be relevant to the genesis of the complemental factor thereof, and so the ratio of *a* to *b* in the terrestrial-orbital predicament is plural—many times as great as the ratio of *a* to *b* in the terrestrial-rotary predicaments. Thus, 365·2563÷30·9=11·820594. The quotient of this division indicates the number of integral rotations made by the new-born Earth in traversing its orbit when its rotary cycle was 30·9 as long as now, while the length of a terrestrial year, notwithstanding the perpetual variation of the Earth's orbital motion, has never varied. But in the interim between the Earth's nativity and its lunar parturition, its primal period of rotation was gradually shortened to parity with 27·321 current earthly days, of which the number *per annum*, collectively equal in duration to our present annual quota, was 13·369. Thus, 365·256357÷27·321=13·369 lunar cycles. Now, if we multiply the quotient of the last division (which represents the number of sidereal months in a solar year) by the number of current days in a lunation, we get the same product as when we multiply the number of the primal Earth's rotations during its orbital period by the number of current days equivalent to its primal rotary period. In plainer terms, 13·369×27.321 =365·2563; and this is also the product of 11·820594 ×30·9. Again, 11.820594 × 1696922 = 20,058,626, which is equivalent to 13·369×1500384; and finally, 20,058,626÷365·2563=54,916. This represents the translated vehicular motion of the new-born Earth, not only in respect of its own rotation, but in that also of the Moon's diurnal motion in its terrestrial orbit, which now, as in the past, is precisely commensurate with the rotary motion of its terrestrial parent.

The foregoing explication is pendent to the assumption that the Moon's primal diameter measured 17,480 miles. This assumption is justified by the coherence of the induction which sustains it, in all but a single point. Its thorough canvass reveals a seeming discrepancy from the principle hitherto maintained as to the dynamic incentive to planetary rotation, namely: that the impetus to a planet's rotary motion is proportional to the primal diametric difference of its vehicular and orbital motions. But the foregoing argument embraces the assertion that the Earth began to rotate so much faster than the Moon was subsequently induced to rotate, because the diameter of the lunar-parturient Earth was virtually 27·321 times as great as that of the new-born Moon. At the same time, it is affirmed that the Earth's original diameter was 30·9 times as great as that of its lunar offspring. Why, then, did not the Earth begin to rotate 30·9 as fast as the primal Moon was induced to rotate?

Answer: The diametric difference of a planet's vehicular and orbital motions is diminished by the inclination of the plane of its equator to the plane of its orbit. The new-born Earth's equator was inclined to its orbit by 5·1428 degrees, and the inclination of the Moon's equator to its suborbit is 1·51428 degrees. By this means, the Earth's primal equator is virtually diminished 193,933 miles, and that of the Moon 1847 miles, according to the subjoined calculation.

1696922 × 5·1428 × 2÷90 = 193933; 1696922—193933=1502989: 54916 × 1·51428 × 2÷90=1847; 54916—1847=53069: 1502989 — 53069 ÷ 53069 = 27·321.

The resultant of this calculation purports that *if* the diameter of the new-born Earth was 30·9 times as great as that of the new-born Moon, nevertheless, the diametric difference of the primal Earth's vehicular and orbital motions in proportion to the same attribute of the new-born Moon, was only as 27·321 to 1.

As this mode of answering the question, may have to some of my readers the aspect of a mathematical conundrum, I will say for their conciliation that it is altogether gratuitous, and may be neglected without a sacrifice of astronomic intelligence: the Moon's non-rotation being more directly accounted for as precluded by its terrestrial gravity, whereby the two factors of planetary rotation, in the lunar predicament which is common to all satellites, were dominated and rendered inoperative.

After all, the Moon's primal magnitude may not have tallied with its said dimensions. It is certain that the identity of its nominal rotary period with its suborbital period is mainly, if not wholly, due to its geoselenic gravity, which, as aforesaid, is purely obstructive to planetary rotation. The declaration of certain scientists that the Moon's solar gravity is more than twice as forcible as its terrestrial gravity, is refuted by the conception that inasmuch as the solar gravity of the Earth and Moon is conjoint and unvarying, geoselenic gravity is unaffected thereby. Therefore the Moon's terrestrial gravity is precisely what it would be if the correlation of the Earth and Moon were insulated. So the Moon's terrestrial gravity excels the Earth's lunar gravity in the same ratio in which the Earth's solar gravity excels that of the Moon, that is as 88 to 1. And since the Moon's solar gravity *per se* is nullified by combination with that of the Earth, the geoselenic gravity is to the distinctive lunar-solar gravity as 89 to 0. Though the unified solar gravity of the Earth and Moon is vastly greater than the geoselenic gravity, its tendency to impede the rotation of either is lessened by their orbital motion, which is 28·64 times as great as the Moon's suborbital motion. Herein consists the complementive reason why the Moon fails to turn on its axis in circumvolving the Earth, and only seems to rotate once in a lunation. It justifies the inference that every satellite of a planet, whatever its magnitude, is non-rotating.

Notwithstanding the Moon's revolution about the Sun in an orbit as broadly-sinuous as the diameter of its parent, its terrestrial circuit is virtually exact and as punctiliously patroled as if the Earth were stationary and its satellite unrelated to the Sun. Though not realized in space and obtaining only in relation to the Earth, the Moon's suborbit is definite in the latter sense, and closely measured as the product of 54916·9343×27.321=1500385·562, which multiplied by the annual number of lunations gives nearly as aforesaid, 20,058,654.

The Earth is swayed slightly by the Moon in the same manner as the Moon is swayed by the Earth relatively to their respective masses. Accordingly, the Moon's circuit round the Sun, though larger, is not otherwise different from the Earth's orbit, and its motion therein simulates the annual variations of the Earth's orbital motion, moving faster in its perihelion than in its apohelion attitude. In fact, the Moon has but one orbit of translatory motion, the main part of which environs the Sun, and from which its motion round the Earth is distinguishable only by conception. In position, this is distinct from the Earth's orbit, and more outside than inside of that; but the twain are anti-sinuous, and cross each other 26 or 27 times annually; a lunation being an aliquant portion of a year. Both the lunar and the terrestrial orbits are compound, each being larger than it would be but for the respective bias of their mutual gravity. The annual result of this dual bias is equal to the annual quantum of the new-born Earth's rotary motion, that is 20,058,654 miles. This quantum is unequally appropriated by the Earth and Moon, in the ratio of 27·321 to 1. Hence we find 20058654÷27·321= 734,184 miles as product of the Earth's lunar-bias *per annum.* Then 20,058,654—734,148=19,324,470 miles *per annum* as product of the Moon's terrestrial bias. The latter of these two products of reciprocal gravity between the Earth and Moon added to the Moon's solar orbit proper, makes its compound orbit 574482779+19324470=593,807,249 miles; while that of the Earth is found by adding to its distinctively solar orbit the product of its lunar bias, 734,184, making 575,216,963 miles, which is 18,590,384 miles less than the compound orbit of its satellite. This difference measures the unequal yet homologous sinuousity of the two orbits.

Elsewhere I have traced out the traductive components of the Moon's quasi-rotary motion, showing that its slowness in comparison with that of primary planets is not at all anomalous, as most astronomers have regarded it. I now purpose to do the like as to the current rotary motion of the Earth, which, though of less than half its primal velocity, is precisely what it should be as inferable from the law of inertia to which all motive powers are amenable.

Though the Earth's diameter at the time of the Moon's birth was over sixty times as broad as now, and its lunar parturient volume thirty thousand times as great as its extant volume, its density was proportionally less; as none of the matter imbodied in its natal form has either perished or been abstracted from it, while an inconsiderable quantity has fallen on its surface from outer space since its nebular parentage. Neither has the momentum of its primigenous rotative energy been impaired during the ages of its condensation otherwise than by translation inward to matter about the axis of rotation, the motion of which has been quickened in the ratio of 27·321 to 1. This procentric acceleration could not obtain without an intromission of equatorial motivity entailing an equal equatorial retardation. Consequently, though the Earth since its superficial incrustation has turned on its axis 27·321 times as often as at the time of its lunar-parturition, its rotary motion on the equator is only as 2·205995 to 1 of its prima velocity. The astronomic lineäge of this induction is given below:

477585 ÷ 7924 = 60·27
27·321 ÷ 60·27 = 2·025995
54916·934 ÷ 2·025995 = 24,894·405

The last quotient of this ternary division is also the product of 7924·1166 × 3·1416, the gauge of the Earth's extant circumference, which tallies with the quantum of its daily rotary motion, namely 24,894·405 miles. Verbalizing the mathematical statement, we perceive its import to be justified. The ratio of the Earth's lunar-parturient diameter to its extant diameter is 60·27 to 1; but this ratio is compromised by the shortened period of the Earth's rotation which at the time of the Moon's birth was 27·321 times as long as now. The quicker rotation of the Earth's lessened volume diminishes the ratio of its former to its extant diameter, reducing it to 2·205995, which is also the ratio of the Earth's primal rotary motion to its current rotary motion, as 54916·934÷24,894.405 =2.205995, and 7924×3·1416=24,894·405, the extant Earth's circumference and daily rotary motion.

The diminuition of velocity in the Earth's rotary motion during the age of its condensation subsequent to the epoch of its lunar-parturition, which is thus accurately measured, has been duly accounted for in preceding paragraphs. As further canvassed here, it proves to be in complete accord with the Pericosmic Theory which it is the prime object of this essay to confirm.

CHAPTER X.

ELEMENTS OF COMPOUND PROPORTION ACCORDING TO WHICH PLANETARY ROTATION OBTAINS.

As evinced in chapter III., the Ether's fitness to serve as the physical agent of gravity must be complemented by the rotation of its volume; and if the ethereal vehicle of matter does rotate, then the issues of nebular evolution depend (in part) upon the adventitious correlation, or compound proportion, of four specific elements of the solar system, as set forth in the following ternary theorem.

1. The rotary motion of a new-born planet is directly proportional to (*a*) its original diameter, (*b*) the diameter of its orbit and (*c*) its orbital motion, and inversely proportional to (*d*) the inclination of the plane of its equator to the plane of its orbit; and therefore—

2. As the product of these factors in relation to any given planet (*A*) is to their product in relation to another planet (*B*), so is the suborbital motion of the oldest satellite of *A* to the suborbital motion of the oldest satellite of *B*. But, restrictively —

3. The proportion expressed by the second part

of this ternary theorem does not obtain in relation to any other than the first-born satellites of *A* and *B*.

This theorem is propounded as an absolute criterion of *the Pericosmic Theory* which this essay is meant to establish. That is not merely consentaneous with this, but the two are logically co-existent, insomuch that it were absurd to affirm the one and deny the other. I am so thoroughly convinced of this, that I shall rest my whole argument for the new cosmology on the astronomic verification of this mathematical premonstration. That is to say, if the principles of compound proportion embraced by the theorem are not deducible from the extant phenomena of the solar system, then I have not found the physical agent of gravity. *Vice versa*, if these data of compound proportion between the said elements of collocated planets are verily adducible from astronomic science, then I have identified the physical agent of gravity with the Pericosmic Ether.

The subject of the theorem is the rotary motion of a new-born planet, the physical cause of which is not patent. Regarded merely as a fact of astronomic observation, it appears to be the joint result of a planet's solar gravity and orbital motion. As exemplified in the solar system, the greater a planet's distance from the Sun the less its solar gravity, and the less its solar gravity the greater its rotary motion. Again, the faster a planet moves in its orbit the less its solar gravity, and consequently (other conditions unchanged) the greater its rotary motion. But these are negative factors, and the apprehension as thus stated is partly illusive. Yet a planet would never rotate if wholly insulated from either of the two forces just named. Though a planet's solar gravity is immediately irrelevant to its rotary motion, which it tends only to extenuate, yet it is mediately and remotely ancillary thereto as a factor of its orbital motion which itself concurs with a planet's vehicular motion to induce its rotation. Solar gravity also plays a latent part as a minor auxiliary to regularity in planetary motion, both rotary and translatory, the cosmologic hinge of which it is important to recognize.

To this object of inquiry it is especially relevant to recollect the remarkable change in bulk and density which a planet undergoes between the first and last stages of its evolution; that the primeval contour of every primary planet outreached the present suborbit of its oldest satellite to an extent ascertainable only as a corollary from the theorem now under consideration. As items of deduction from that, it must be conceded that the equatorial circumference of the new-born Earth was 1696922 miles; that of new-born Jupiter, 7,943,810 miles; that of new-born Saturn, 14,906,725 miles; and that of new-born Uranus, 9,958,000 miles. It is needful also to con ceive the difference of vehicular motion to which a planet is subject in different parts of its orbit, in effect of which, as heretofore explained, the Earth's mean orbital motion is alternately increased and diminished nearly one-twenty-fifth of its semi-annual quantum. The like is true of all the planets, for no other reason than the varying distance of each from the axis of the world's rotation, the conception of which, entailing as it does the alleged diametric difference of a planet's vehicular motion as counterpart to the assured diametric difference of its orbital motion, premonstrates the Pericosmic Theory with its dependent rationale of planetary rotation.

As to the data of compound proportion referred to in the heading of this chapter, I have discovered and am able to present only those pertaining to planets which have satellites, or whose satellites have been duly cognized. It is said of Mars and of Venus that each has a satellite, but I have not met with any proper description of either. Astronomers have reported the elements of one satellite of Neptune, with surmise of others in the same family relation; but, as tested by the theorem propounded above and about to be maintained, these elements do not pertain to the *oldest* satellite of that primary. The first-born of Neptune is yet to be discovered. As to Uranus, Burritt, in his *Geography of the Heavens* published more than 50 years ago, said plainly: "Uranus is attended by six moons. Four of them were discovered by Sir William Herschel, and two by his sister, Miss Caroline Herschel. It is possible that others remain yet to be discovered." This positive assertion is afterward qualified by the remark that "Sir William Herschel reckoned six, though no other observer has confirmed this opinion;* and even his son, Sir John

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*A misnomer: Herschel named it fact.

Herschel, seems to consider the existence of six satellites quite doubtful." This high-born doubt, out of respect for its alleged parentage, has become conventional. So Prof. Loomis, Lockyer, Proctor and other astronomers of later times omit from their accredited list of satellites the first-and-second-born of Uranus; and of course the school-teachers assure their pupils that *four* Titans are sufficiently incredible and enough for the nonce of Uranian moonshine. "Seeing is convincing," and Sir John Herschel had seen but two of the six which his predecessors had seen when he wrote in his *Outlines of Astronomy*: "Of the remaining four, whose existence, though announced with considerable confidence could hardly be regarded as fully demonstrated, two only have been re-discovered." "Hardly regarded"— wherefore? The discover was a *woman*! I can think of no better reason for *that*. There is a better reason for believing that the elder Herschel himself was not mistaken as to his estimate of his sister's aptitude for astronomic observation, when he consented to calculate for her the elements of those very satellites whose existence the younger Herschel "hardly regarded" as probable. Is it likely that Sir William himself neglected to confirm with his own eyes the accredited stellar vision of his professional colleague?

Now I am going to quash the dubiety so generally entertained respecting those two trophies of feminine assiduity, by dint of mathematical suasion—by showing that the more distant of the two satellites in question is an ascertained verity; and, as a grateful memento of Miss Herschel's telescopic researches, I expect to vindicate a reasonable desire that the said object of her discovery may yet be named with a befitting personal allusion. Conventional assent to this proposal is not to be expected, however, in advance of accrediting the theorem whereby the the alleged reality is verified.

The argument to that effect is two-fold, presumptive and demonstrative; or I may call these divisions subjunctive and indicative. But, preliminary to either branch of it thus designated, it should be understood that the theorem as formulated above does not indicate, *prima facie*, the proper factors of planetary rotation. The causal incentive to that is not patent, nor directly suggested by its phenomenal issues. Its factors are *measured* by the terms of the ratio denoted by *a*, but are not identifiable therewith. Yet these, as measurements of those, are usable as mathematical equivalents. As to the other three ratios, *b*, *c* and *d*, they import what is merely restrictive; *d* representing the dissidence of trend as to two otherwise-congenial motions (orbital and rotary), while *b*, and *c* represent diminutions of solar gravity as negative aids to planetary rotation which solar gravity can only obstruct. Thus *b* and *c*, hinging as they do upon one and the same principle, are reducible to unity; which shows that the theorem is susceptible of another formula; so that if the primal solar gravity of planets were to be readily ascertained, the first part of the fore-stated formula of the theorem would be practically replaced by the following.

The rotary motion of a new-born planet is directly proportional to (*a*) the diameter of its volume, and inversely proportional to (*b*) its procentric gravity and (*c*) the inclination of its equator to its orbit.

As *b* and *d* in this proportion connote only obstructive tendencies, it follows logically that *a*, as an exponent of causal agency, includes all that is relevant to planetary rotation. By this showing, *b*, *c* and *d* are ruled out of relation to the immediate question: so that to maintain the validity of *a* is all that is requisite to sustain the theorem, so far as the presumptive part of my argument may be effective.

Now as to *a*—the affirmation that the rotary motion of new-born planets is proportional to their diameters (*cœteris paribus* of course), it is enough to say that it is a corollary from the world's rotation. If the planets are subject to vehicular motion germane to the Pericosmic Theory, every planet's predicament must entail a diametric difference of its vehicular motion just equal to that of its orbital motion, as expounded in chapter VII. In conceptive view of these two alleged factors of planetary rotation, posited antithetically to each other and culminating with diverse trends at points hemispherically opposite and equi-distant from the axis of a planet, two propositions become self-evident, to wit: that a planet in such a predicament must perforce rotate; and that its rotary motion must be proportional to the diameter of its volume.

And now, by way of approaching the second division of my argument for the theorem, to justify my retention of its indirect formula after having discovered its direct statement, it may suffice to say that the greater the diameter of a planet's orbit, the greater is its distance from the Sun; the greater its distance from the Sun, the less is its solar gravity; and the less its solar gravity the slower its orbital motion: also, the greater its distance from the Sun, the larger its orbit and the further it has to travel, periodically. Then, putting that and this together, the larger its orbit and slower its orbital motion, the longer its orbital period. Now, a planet's orbital period is the exponent of the ratio of its orbital motion to its orbit. The length of a planet's orbital period depends upon the spacial antecedent and motoric consequent of this ratio, and upon nothing else. This ratio, *alias* orbital period, is directly proportional to a planet's distance from the Sun, the cube of this being proportional to the square of that: though the orbital motion of a planet is inversely proportional to the dimensions of its orbit; whence ensues the restrictive bent of *b* and *c* as modifiers of a planet's rotary motion, one of the proper factors of which is an outcome of orbital motion to which rotary motion is directly proportional.

The theorem's quaternary formula is justified by the rationale of its distinctive ratios, while its compositive justification appears only in the light of analysis. Therefore, I repeat with less complexity—

If the physical world does verily turn on its axis, but not otherwise, then—

1. The greater the diameter of a planet's primi-

tive volume, the greater must be the diametric difference both of its vehicular and of its orbital motion, which constitute the proper factors of its rotary motion. These are equal and unvarying, for—

2. Though the orbital motion of a planet, as well as vehicular motion, is alternately accelerated and retarded by its translocation in relation to the axis of the rotating pericosm, yet the primal diametric difference of each is constant.

3. The greater the diameter of a planet's orbit, the greater its rotary motion, because the greater its distance from the Sun the less its solar gravity. So the greater the velocity of a planet's orbital motion the less (virtually) its procentric gravity which is rivaled by centrifugation. But then—this opponent of gravity is alike repugnant to a planet's rotation, which therefore is neither helped nor hindered by the variant locomotion of its axis.

4. The inclination of a planet's equator to its orbit is obstructive to its rotary motion, and why? Because the two factors of this, namely, the diametric difference of its vehicular motion and the diametric difference of its orbital motion, are extenuated by the divergence of their antithetic trends from a single plane; this divergence being equivalent to a diminution of a planet's diameter.

5. The genetic principle of planetary rotation applies exclusively to new-born planet's. Neither solar gravity nor its dynamic antithet can have much effect on the rotary motion of extant planets, whose rotation is due to the momentum of its primigenous

impetus; that being proportional to the planet's natal diameter.

6. The two factor's of a planet's semi-rotative impetus given above, are made doubly effective by the transverse momentum of their conspiring hemispheric trends.

The conclusive part of my exposition of the theorem in its available form consists with deploying the correlative astronomic data of compound proportion relevant to the rotation of new-born planets. It is predicable of every two primary planets of the solar system, though empirically verifiable only of those the elements of whose oldest satellite have been discovered. The following five paradigms of its application are representative of its cosmologic purport.

I. The Earth and Jupiter.

$$\left.\begin{array}{lrcl} (a) & {}^{*}270 & : & 1264^{\dagger} \\ (b) & 91 & : & 475 \\ (c) & 1572 & : & 689 \\ (d) & 6{\cdot}7345 & : & 5{\cdot}142 \end{array}\right\} :: 54{,}916 : 449{,}084 = e \text{ of ocular evidence.}$$

(e) $1192820 \times 3{\cdot}1416 \times 2 \times 45 \div 745 = 449{,}084$ miles.

II. The Earth and Saturn.

$$\left.\begin{array}{lrcl} (a) & 270 & : & 2372^{\ddagger} \\ (b) & 91 & : & 872 \\ (c) & 1572 & : & 509 \\ (d) & 42 & : & 5{\cdot}142 \end{array}\right\} :: 54{,}916 : 183{,}262 = e \text{ of ocular evidence.}$$

(e) $2314000 \times 2 \times 3{\cdot}1416 \times 288 \div 22847 = 183{,}276$ miles.

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* The circumference of the new-born Earth was 1696922 miles, which, being divided by twice *pi*, gives 270,072 miles as its radius.

† The circumference of new-born Jupiter was equal to the

III. Jupiter and Saturn.

$$\left.\begin{array}{lrcr}(a) & 1264 & : & 2372\\ (b) & 462 & : & 872\\ (c) & 689 & : & 509\\ (d) & 42 & : & 6{\cdot}7345\end{array}\right\} :: 449 : 183 = e \text{ of ocular evidence.}$$

IV. The Earth and Moon.

$$\left.\begin{array}{lrcr}(a) & 477586 & : & 17480\\ (b) & 575216967 & : & 593807347\\ (c) & 1574831 & : & 1625727\\ (d) & 20{\cdot}2 & : & 5{\cdot}142\end{array}\right\} :: 24{,}894 : 247 = e \text{ of ocular evidence.}$$

$$(e)\ 2153 \times 3{\cdot}1416 \div 27{\cdot}321 = 247{\cdot}57 \text{ miles } \textit{per diem.}$$

V. The Moon and Earth.

$$\left.\begin{array}{lrcr}(a) & 17480 & : & 477586\\ (b) & 593807347 & : & 575216967\\ (c) & 1625727 & : & 1574831\\ (d) & 5{\cdot}142 & : & 20{\cdot}2\end{array}\right\} :: 247 : 24{,}894 = e \text{ of ocular evidence.}$$

$$(e)\ 7924 \times 3{\cdot}1416 \div 1000 = 24{,}894 \text{ miles } \textit{per diem.}$$

Here are five paradigms of the numerous correlations of planetary attributes which appertain to the Solar System, making so many verifications of what the theorem affirms as germane to every two immediate offsprings of the Solar Nebula, as well as to each planet in relation to its oldest satellite. Three similar paradigms, based upon the correlations of Uranus with the Earth, with Jupiter, and with Saturn, respectively, are reserved for elucidating the subject of the next chapter; and four others, not as yet practible, will become adducible from Neptune's correla-

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orbit plus the equator of its first-born satellite, which divided by twice *pi* gives 1264,293 as its radius.

‡ The circumference of new-born Saturn was 2314135 into 2 into 3·1416 plus twice the circumference of its oldest satellite= 14,906,725 miles, which being divided by twice *pi* gives 2372,473 miles as its radius.

tion with each of the primary planets just named, when Neptune's first-born satellite shall have been discovered. But these five examples are sufficient for the purpose they are meant to serve. Versed astronomers must see at a glance the unitive purport of this many-faced formula of compound proportion; though a few words of explication may be relevant to the same reach of intelligence by the general reader, to whom it may not be obvious that the terms of each ratio thus compounded are abriged exponents of correlated facts, either extant or historic, collectively modifying the rotary motion of planets, of which *a* represents the primal diameters (or radii), *b* the diameters (or radii) of their orbits, *c* their respective orbital motions, and *d* the inclination of their equators to their orbits. The structure of the first three of the given paradigms being homologous, to explain one of them is to elucidate all its similitudes. In paradigm I. the numeral conjuncts of *a* are the radius of the new-born Earth and that of new-born Jupiter, given in units of 1000 miles; those of *b* are the radius of the Earth's orbit and that of Jupiter's orbit, in units of 1,000,000 miles; those of *c* are the daily orbital motion of the same planets respectively in units of 1000 miles; while those of *d* report the inclination of their primal equators to their perpetual orbits. The primal rotary motion of any planet is represented by the letter *e*. Of paradigm IV. it is to be further noted that *a* is conjoined with the diameters of the lunar-parturient Earth and of the Moon, *b* with the circumference of their orbits expressed in units of 1000 miles, and *c* with their daily orbital motions in units of a mile, the import of *d* being the same as in the foregoing paradigms. The first term in this 4th ratio in the geoselenic paradigms, though novel, is based upon no new principle, being the inclination of the Moon's equator to its orbit multiplied by the number of lunations in a year, that is to say *one and twenty-three forty-fifths* of 13.369 =20·202 years. Paradigm V., as the geoselenic antithet of paradigm IV., exemplifies the potential duality of evidence predicable of each mode of the theorem's application.

Thus the first and second divisions of the foreshown thorem are mathematically ratified. These embrace all that pertains to the positive scope thereof. As to the third division, it neither adds to nor derogates from the foregoing exposition. It merely restricts the application of its principle, and this limitation is what remains to be expounded. Its verification is effected by the frustration of all attempts to apply the theorem by means of any other than the oldest satellite of a primary planet. Callisto is the sole index to the natal magnitude of Jupiter; the suborbit of Japetus alone reveals that of Saturn, and so that of Uranus is connoted by the elements of Caroline:* and the implication of this astronomic fact, which is bound to be recognized conventionally, certifies the reality of Miss Herschel's discovery, and thus answers a long-mooted question in astronomic science. Here are several items of novel intelligence whose cosmologic suggestiveness entitles them to considerate attention.

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* The proposed classic name of the elder of the two satellites of Uranus whose existence has been doubted.

It is perceived on inspection that each of the propounded paradigms of the theorem's solution is germane to the oldest satellite of the family to which the two planets named in its heading belong; but it does not appear in the light of this showing that the terms of the ratio denoted by *a* are deducible from the oldest satellite of a family *exclusively*. Without further inquiry, it might be supposed that the later-born satellites would serve the same mathematical purpose as that fulfilled by the first-born; but they will not, for the reason that no two satellites of a given planet *after a parturition* move with proportional velocity. Every later-born satellite moves faster than its predecessor. Of Jupiter's four satellites, the first in the order of their successive evolutions moves in its suborbit 449 thousand miles a day, the second 595 thousand, the third 752 thousand, and the fourth 949 thousand; and a like statement applies to the satellites of Saturn as well as to those of Uranus. In every family of planets, primary or secondary, the trend of gradation respecting the different velocities of its locomotive members is incremental from senior to junior; and this because the parentive antecedent thereof rotated more and more rapidly from birth to maturity, or turned on its axis in less and less time in proportion to the lessening of its bulk by gravity; secondary planets being evolved from primary by the same prescriptive process as that through which the lineal progeny of the Solar Nebula has been evolved. The incremental rotary motion of this grandmother of moons has been already explained, and it may suffice to say here that the serial accelerations of a planet's rotary motion between the consecutive births of its satellites are homologous to those of its nebular parent, and due to the same functional predicament of the two pericosmic forces, namely, the concentric and the excentric.

The negative truth here adverted to has yet a positive significance. It purports the reality and universality of the proportion affirmed by the theorem. In fact, this is inapplicable to the younger satellites of a family for no other reason than our inability to gauge the process of planetary condensation, knowledge of which would enable us to deduce from its motoric outcome all the elements of a satellite's lineage. For each paradigm of the theorem's proper application connotes the dependents of planetary proportion on a dual agency which is pericosmic, co-ordinating, without identifying, the spring of Matter's locomotion with the physical cause of its gravity and gravitation.

CHAPTER XI.

ASTRONOMIC AVAILS OF THE FORESHOWN THEOREM.

The truth of the theorem of planetary rotation being fairly established, its special utility as an item of science is näively assumed. Belief in the unexceptional availability of intelligence concerning the attributes of Nature is conventional and universally cherished; and whatever diversity of opinion may obtain as to what is predicable of Nature's physical characteristics, nobody doubts that knowledge of them is relevant to human aims. It is reasonable therefore that assent to the theorem should incite inquiry as to what it may be good for; which question I shall attempt to answer in this chapter only within the scope of its astronomic uses, that is inasmuch as it is practicably suplementive of telescopic observation. The base of its utility in this sense is its fitness to serve as an infallible criterion as to whether a given satellite of a planet is or is not the first-born of its family. This function is objectively-versatile, being employable to several distinctive issues which it is proper to consider in serial order.

I. By means of the mathematical process which the theorem enjoins for its confirmation, it assures us that Callisto is the oldest satellite of Jupiter, and also that Japetus is the first-born of Saturn; facts concerning which telescopic vision alone yields but negative testimony. This may be regarded as the least-important of the theorem's astronomic uses, merely for the circumstance that its application is rendered less needful in the case of these two planets than in that of Uranus and Neptune, whose comparative remoteness favors the seclusion of their satellites from the stinted range of our prying exploration. The telescopic conspicuousness and consequent nautical availability of Jupiter's moons has promoted the scientific study of their motions concerning which pre-eminent intelligence has thus been superinduced, enforcing the inference that their number has been completely discovered. Some points of this remark apply also to the moons of Saturn, incentives to the study of which, though apparently less prudential—less for sake of thrift—seem to have proved hardly less successful. But the progeny of Saturn, as well as that of Jupiter, is locally within bounds of optical research. The whole region of space wherein these two objects of astronomic interest are permanently stationed, is open to inspection by inquisitive eyes, insomuch as to warrant the conventional belief that the retinue of either has been visually perceived and correctly reported. But the question as to which member of either family is the first-born—whether the oldest of its *known* members have or have not an elder—is answered more curtly, and to absolute certainty, only by means of the propounded theorem.

That the visual cognoscibility of secondary planets whose solar orbits are exterior to that of Saturn is greatly diminished by their excessive distance from our planet, is intimated by the fact that astronomers are not as yet agreed as to the number of Uranus's moons, as well as by the tardy visual discovery of Neptune and one only of this outmost planet's satellites. For the reason thus suggested, it is to the dependents of these two outer-ranged members of the Solar System that the theorem is applicable with most express utility, the practical modes of which are now to be specified.

II. The theorem serves to demonstrate that Neptune's oldest satellite is yet to be discovered. Though this first-born of the Solar Nebula was seen as early as 1795 of our era, it was apprehended and catalogued as a fixed star, and not recognized as a member of our planetary community till Sept. 1, 1846, by M. Leverrier of Paris and Mr. J. C. Adams of Cambridge, England; Mr. Lassell's discovery of its only recognized satellite being made six weeks later. The number of Neptune's moons is scientifically presumed to be plural, though its plurality has not as yet been telescopically revealed. But the telescope has revealed what is mathematically available to a proximate answer of the question. Application of the theorem to the calculated elements of Neptune's only recognized satellite discloses the information that this is not the oldest offspring of that planet; from which it follows that his progeny is plural. The mode of this information is given below, that the reader who would *see* the truth here stated may repeat the process of its verification. The gist of this is negative — the disagreement of the inductive issue of the problem with (*e*) the computed motoric element of the satellite, which is indisputable. If the satellite in question were the oldest of its class, the issue of the process formulated below would be equivalent to *e* of its own *positus*. Those of its computed elements which are requisite for the mathematical test of its seniority, are —

Distance from Neptune, 220 thousand miles; period of suborbital revolution, 5 days, 21 hours, 8 minutes; inclination of the plane of its solar orbit, 157° direct, or 23° reverse, measurement. So the suborbital motion of said satellite, equivalent to the rotary motion of its planetary antecedent, namely, Neptune at the birth of the same, is (*e*) $220{,}000 \times 2 \times 3{\cdot}1416 \times 360 \div 2117 = 235{,}058$.

These elements of Neptune's first-discovered satellite pertain also to Neptune itself as historic antecedents thereof; the present suborbit of the satellite being identifiable with the *quondam* equator of its planetary parent, and the inclination of its suborbit to its solar orbit being due to the primal inclination of Neptune's equator to his orbit, which also is identifiable with the equator of his nebular parent, the Solar Nebula at the epoch of Neptune's birth.

Herein is grounded the rationale of compound proportion predicable of the corresponding elements of each and all the primary members of the Solar System, including the first-born of each family of satellites. The theorem is based on this truth, and therefore is applicable to any two immediate products of the Solar Nebula, as said above. Of course, then, the proposed mathematical test admits of several modes of exemplification, being practical by pairing Neptune with any other primary planet whose first-born satellite is cognized as such. In the subjoined mode of settling the question, the component ratios of its quinquary process are formed by contrasting the elements of Neptune and his discovered satellite, at the epoch of the latter's nativity, with those of the Earth as parent of the Moon, thus:

$$\left.\begin{array}{lrcl}(a) & 238 & : & 220\\ (b) & 91 & : & 2746\\ (c) & 1572 & : & 286\\ (p) & 23 & : & 5{\cdot}142\end{array}\right\} :: 54{,}916 : 62{,}084 \text{ miles, less than one-third of } e.$$

If 157° be made the first item of the 4th ratio (*d*) instead of 23° as above, the last term of the 5th ratio becomes 25.74 miles, about 1-25 of *e*.

The simple question, whether or not the first-discovered satellite of Neptune is the first-born of that planet, is thus answered categorically, *No*; and the inference follows perforce, *Then it must have an elder.* Other questions arise, and we are left to query still as to the number of his progeny, which we now know to be plural.

The process by means of which satellites are evolved being analogous to that through which primary planets are evolved, both are subject to the same law of cumulative motivity, according to which each member of a genital series of planets moves faster than its predecessor. The Solar Nebula rotated eight and four-fifths times as fast, at the birth of Mercury as at the birth of neptune. So the rotary motion of Jupiter was twice as rapid at the birth of Io as at the birth of Callisto; and Saturn's rotary motion was more than four times as rapid at the birth of Mimas as at the birth of Japetus. The same statement in principle applies also to Uranus, whose rotary motion was three and two-fifths times as great at the birth of his youngest offspring as at the birth of the first-born of his progeny.* The implication of these astronomic truths is the probability that Neptune's rotary motion at the nativity of his first-born satellite was about 1-4 of what it was at the birth of the satellite of Mr. Lassell's discovery, the suborbital motion of which is 235 thousand miles a day. This is two-and-three-fifths times 62.084, the inductive issue of the mathematical project given above. If now, for the 2nd term (220) of the ratio denoted by *a* in that performance, we substitute 1500, replacing 23 with 157 for the initial term of *d* (the direct for the reverse measurement of the obliquity of the satellite's suborbital to its orbital motion), the inductive issue almost equals that adduced above, to wit: the latter is 62,149. Not for this coincidence alone, but in view of the whole aspect of the question, for a rough guess, I fancy the oldest satellite of Neptune is distant therefrom about 1500 thousand miles, moving in its suborbit say 70 thousand miles a day. That would make its period of revolution round Neptune 135 days. But this is an item of speculation. The scientific product of the theorem's application in this instance begins to be apprehended with its demonstration that the discovered satellite of Neptune is a junior member of a family of secondary planets. This jot of foresight ought to be encouraging to a telescopic explorer of those outer regions of the Solar System whose contents are as yet but imperfectly known. To be assured that the object of assiduous research is real and posited within the range of ocular inquest must be relevant to that degree of patient persistence in wielding optical instruments for the nonce which is generally requisite to success in practical astronomy, and without which no enlargement of our present knowledge of Neptune and his secluded progeny is probable. Yet, so long as with most scientists "seeing is convincing," rather exclusively, I anticipate the deferred assent of my very intelligent readers, a prominent word in whose comments hereabout is "problematic." That is a word of amiable propensity, rational and almost scientific. Till truth appears, every truth-seeker is disposed to wait. Meanwhile, in this predicament, let us see what is more readily discernible,—another astronomic fact of kindred mien to the foregoing also revealed by the theorem, the benefits of which are more appreciable for that we have not to wait for them.

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*If the figure of speech here employed savors too much of incongruity for the literary taste of my readers, I can only say that I agree with them, but am not responsible for the masculine naming of celestial entities whose patent features are suggestive of maternal attributes. The rhetorical gender of every life-bearing planet is poetically feminine.

III. Application of the theorem to Uranus and the four conventionally-recognized of his satellites demonstrates that none of these is the first-born of his progeny. A single trial suffices to test the truth of this proposition, since if the issue of its application to the eldest of a class be discrepant from *e* of its suborbital *positus*, that of its application to any junior of that class will be still more discrepant therefrom. The pertinent ordeal is formulated below.

Oberon, the oldest generally-recognized satellite of Uranus, is distant from that primary planet 376 thousand miles. Its suborbital period is 13 days, 11 hours, 6 minutes, making 175 thousand miles a day, as

$$(e)\ 376{,}000 \times 2 \times 3{\cdot}1416 \times 720 \div 9693 = 175{,}000.$$

But—

$$\left.\begin{array}{lrcl} (a) & 238 & : & 376 \\ (b) & 91 & : & 1753 \\ (c) & 1572 & : & 359 \\ (d) & 80{\cdot}33 & : & 5{\cdot}142 \end{array}\right\} :: 54 : 24 \text{ thousand miles, which is less than one-seventh of } e.$$

The evidence thus obtained that Oberon is not the oldest satelite of Uranus, is equivalent to a demonstration that his progeny is more numerous, at least by one, than living astronomers have hitherto known it to be; and this discovery is valuable by implication as an unequivocal response to an open question in the history of progressive astronomy.

The question here referred to is not normally scientific. It savors more of dubitation, if not of dogmatism, than of inquiry relevant to intelligence. It has obtained upon negative premises without a whit of positive information for its rational countenance. Its pedigree is respectable, and that is all that may be said in its behalf. It was born as a simple query in the mind of Sir John Herschel whether or not the two satellites outside the suborbit of Oberon, which his aunt claimed to have discovered and the elements of which his father computed, were real objects of sight.

Was this unwarrantable query sired by the vulgar opinion that a feminine observer may be suspected of optical illusion, and that a creditable desire to gratify an amiable sister may have rendered even Sir William Herschel a mite too credulous? Possibly; but such a thought is repugnant to the bias of generous minds, and needs not be entertained. It is more likely that dubitation in the case was first incited by Sir John Herschel's repeated failure to rediscover the said satellites of traditional repute. Then followed the serial disappointments of several would be confirmers of the elder Herschel's presumed scientific assurance; till at length, tardily of course, somebody in the crowd of Old Authority's patrons started the rumor that what the younger Herschel of living renown failed to descry with his father's big telescope probably was not there.

A single reflection germane to the objective counterpart of the said query will both palliate the acerbity of its history and complete the rationale of the current opinion among living astronomers that Uranus has but 4 satellites. Though the volume of this primary planet is more than 80 times as large as our terrestrial world, its visual disk is minified by remoteness to the semblance of a minute star for which it was mistaken by several close observers prior to 1781, when Sir William Herschel detected its real character. Such being the cryptic predicament of Uranus himself, no wonder that the prying assiduity requisite to a glimpse of his equally minified progeny has been exemplified (as to two members thereof) only by a *single woman.* But this remark is worthy of qualification. It is not at all likely that Sir William Herschel neglected his opportunity to view with his own optics the trophies of his sister's devotion to the aims and interests of their co-equal calling. Indifference to the fortune of an associate in any capacity is unnatural, and in the case of their twofold alliance it would be incompatible with a sound mind. His calculating the elements of her discovery must therefore pass for a paramount attestation of its objective reality. That was equivalent to his verbal statement that the two satellites were both discovered by her and re-discovered by him. *Per contra,* too much account has been made of Sir John Herschel's failure in that comparatively small province of his professional agency; it being notorious that he was engaged during most of his career, in exploring foreign regions of the Cosmos, and that apart from his pursuits in general astronomy he found little time for the purpose of duplicating the special achievements of his predecessors.

Now, in this view of the subject, it is much to say of the astronomic utility of the theorem that it is good for the quietus of the said query as well as of its traductive assumption, namely, that Uranus has but four moons. Nay, what is more edifying than even this contravention of scientific stricture,—

IV. The theorem of planetary rotation is meet to certify the reality of Miss Herschel's discovery, at least in respect of the senior of the two satellites whose existence has been conventionally disputed, and verifies the correctness of Sir William Herschel's estimate of its elements. These, as reported by Sir John Herschel in his *Outlines of Astronomy*, are,—

Distance from Uranus, 1,556,000 miles; period of suborbital motion, 107 days, 16 hours, 39 minutes, 56 seconds, making 90,781 miles a day, as found by computation thus:

(*e*) $1556000 \times 2 \times 4{\cdot}1416 \times 1200 \div 129233 = 90{,}781$.

That these computed elements of the alleged (miscalled sixth) satellite of Uranus are pertinent to the first-born of his progeny, is made certain by the following triple test.

1. *Earth and Uranus.*

$$\left.\begin{array}{lrr} (a) & 270: & 1585^{*} \\ (b) & 91: & 1753 \\ (c) & 1572: & 359 \\ (d) & 80{\cdot}33: & 5{\cdot}142 \end{array}\right\} :: 54{,}916 : 90{,}785 = e \text{ of ocular evidence.}$$

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* The circumference of new-born Uranus was equal to the suborbit plus twice the equator of its first-born satellite which divided by twice *pi* gives 1,584,894 miles as its radius; the period of its rotation being 109·69499.

2. *Jupiter and Uranus*..

$$\left.\begin{array}{lr}(a) & 1264 : 1585\\ (b) & 475 : 1753\\ (c) & 689 : 359\\ (d) & 80{\cdot}33 : 6{\cdot}7345\end{array}\right\} : : 449{,}084 : 90{,}782 = e \text{ of ocular evidence.}$$

3· *Saturn and Uranus.*

$$\left.\begin{array}{lr}(a) & 2372 : 1585\\ (b) & 272 : 1753\\ (c) & 509 : 359\\ (d) & 80{\cdot}333 : 42\end{array}\right\} : : 183{,}276 : 90{,}785 = e \text{ of ocular evidence.}$$

The reader is thus presented with a three-fold demonstration that neither was Miss Herschel too visionary nor her brother too confident of her visual expertness and precision as an astronomic observer. It proves the almost equal professional merit of the *two* elder Herschels of consociate repute, the avails of whose partnership in practical astronomy were well-acclaimed by their contemporaries, though "hardly" commemorated by the younger Herschel. But the demeanor of living astronomers who have entered into the labors of the *three* Herschels in the main of their vocation, have done what is less dutiful than is putative of Sir John. They have tacitly torn a wreath from the brow of the one notable feminine astronomer of modern times. In the recent lists of Uranus's satellites, Sir William Herschel is credited with the discovery of each and all whose existence is thought to be verifiable. Yet Sir William himself testified that two were discovered by his sister, the very two which none but her brother has re-discovered. Because of the visual failure of later astronomers, and for no other reason, the two alleged trophies of Miss Herschel's success have come to be ostensibly ignored, and her name is not mentioned in any promulgated list of the planets and their discoverers that I have seen.

Now, as foremost herald of the mathematical evidence that Miss Herschel's discovery was genuine, I respectfully submit to the civilized world the propriety of naming its stellary objects for their discoverer. The proper conventional name of Uranus's first-born satellite is "*Caroline.*"

The other satellite which glitters in the conceptive wreath of which Miss Herschel has been rudely despoiled, if real is posited at half the distance from Uranus which is certified of his first-born; but whether it be his 2nd or 3rd in the natal order of his progeny is not as yet ascertained, nor is it even problematic. As computed by Sir William, its *positus* is 777 thousand miles from its parent round which it circles in 38 days, 10 hours, 48 minutes, making by its suborbital motion 126 thousand miles a day. Being twice as far from Uranus as is Oberon, between which and Uranus three junior satellites are posited, it is likely that two other satellites are collocated, one on each side of "*Lucretia*,"* as I am minded to name the hitherto unnamed satellite of Miss Herschel's discovery, for a casual side-hint of her neglected memory. Who can deny or who is disposed to ignore, or who is mean enough to set at naught, the prescriptive right of a noble woman to the only-feasible memorial of her uniquely-useful vocation? Surely, not any votary of practical astronomy, whose classic incentive to magnanimity is unimpeachable; and the apparent snub of a peer in this case is better conceived as an oversight.

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* Miss Herschel was double-named "Caroline Lucretia."

For reasons partly stated above and others hereby suggested, the primal magnitude of Uranus's volume as connoted by the *positus* of its first-born satellite, makes it more probable that the number of its progeny is 8 or 10 than only 4 or 5.

CHAPTER XII.

WHAT VALIDATES THE NEBULAR HYPOTHESIS.

The proportional movements of planets in the Solar System depend upon their collocation and conveyance in a common vehicle. This vehicle must be that of all Matter. Such vehicular motion as may be effective of planetary motion can proceed only from the rotation of the pericosm as the antecedent of nebular rotation. The orbital motion of planets is no less dependent upon the axial rotation of the pericosm than is their vehicular motion. The rotation of the pericosm generated that of the Solar Nebula which in turn generated the orbital motion of each planet; the rotation of planets being traductive immediately from their own vehicular motion conjointly with their orbital translocation. In this way the theory of cosmic evolution is to be complemented and verified. It is only for ignoring the world's rotation that this desideratum has been thus far deferred. Though Laplace and his disciples have long since deduced the orbital motion of planets from the rotation of the Solar Nebula, no successful attempt has been made to find the rationale of nebular rotation, which is to be accounted for only as the outcome of the Solar Nebula's vehicular motion. The genesis of nebular rotation is a problem of which no conventional solution has as yet obtained. The speculative style of dealing with this problem by the *elite* of physical scientists is fairly represented by the following paragraph of Mr. Herbert Spencer's defense of "*The Nebular Hypothesis.*"

"The general nature of Laplace's theory scarcely needs stating. Books of popular astronomy have familiarized most readers with his conceptions, namely, that the matter now condensed into the solar system, once formed a vast rotating spheroid of extreme rarity extending beyond the orbit of Neptune; that as this spheroid contracted, its rate of rotation necessarily increased; that by augmenting centrifugal force its equatorial zone was from time to time prevented from following any further the concentrating mass, and so remained behind as a revolving ring; that each of the revolving rings thus periodically detached, eventually became ruptured at its weakest point, and contracting on itself, gradually aggregated into a rotating mass; that this, like the parent mass, increased in rapidity of rotation as it decreased in size, and, where the contrifugal force was sufficient, similarly threw off rings which finally collapsed into rotating spheroids; and thus out of these primary and secondary rings there arose planets and satellites, while from the central mass there resulted the Sun. Moreover, it is tolerably well known that this *a priori* reasoning harmonizes with the results of experiment. Dr. Plateau has shown that when a mass of fluid is, as far as may be, protected from the action of external forces, it will, if made to rotate with adequate velocity, form detatched rings; and that these rings will break up into spheroids which turn on their axes in the same direction with the central mass. Thus, given the original nebula, which, acquiring vortical motion in the way we have explained, has at length concentrated into a vast spheroid of aëriform matter moving round its axis—given this, and mechanical principles explain the rest. The genesis of a solar system displaying movements like those observed, may be predicted; and the reasoning on which the prediction is based is countenanced by experiment."

In Dr. Plateau's experiment thus alluded to there is one item which Mr. Spencer seems to have overlooked, namely, that the "mass of fluid" representing the newly-formed Solar Nebula had a receptacle, without which the experiment could not be made. It was this *vehicle* of the fluid which was made to rotate, and thus the fluid obtained *vehicular* motion. Dr. Plateau's experiment has been repeated by others, and on this side of the Atlantic, particularly at the scientific cabinet in Washington, D. C., known as the Smithsonian, and a man of science writing from that locality to a Boston periodical, * not long ago, briefly described its process as below.

"In its function of diffusing knowledge among men, our Smithsonian has introduced to the English-speaking world the researches of Plateau on the forms assumed by a liquid mass withdrawn from the action of gravity. Olive oil in a mixture of alcohol and water breaks into molecules which lie suspended in the fluid as world-mist of a nebula is suspended in space. Give spiral motion to the fluid, and the mole-

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*W. D. Gunning in *The Index*, Jan. 3, 1884.

cules of oil gather themselves into a globe, and you have the beginning of a system epitomizing the solar system. The sphere spins on its axis, becomes oblate like the Earth, and then detaches a ring from the equator. It is now a mimic Saturn. The ring breaks, and each fragment becomes a secondary sphere, revolving around the primary. We have only to hypothecate a nebulous mass diffused through space, and then such a motion as we give to the fluid, and we have accounted for the genesis of a solar system. Not quite. Clifford subjected this experiment to his powerful analysis, and showed that a hypothetical "experimenter" would have to twirl the world-mist, and do many other things."

But the analyzer should comprehend his theme. In the case here cited, the objector erred in comparing the artificial phenomena with the evolution of a nebula instead of the Cosmos, as well as in positing the world-mist in empty space instead of the Ether. The proper way to twirl the analogue of world-mist is to twirl its receptacle. In fact, the cosmologic purport of the experiment depends upon the very condition which apparently impugns it—as it does only in the short-sighted view of fancy. A solution of olive oil in a mixture of alcohol and water is analogous to diffuse matter in the pericosmic ether. The rotation of the pericosm gives vehicular motion to the world-mist which is thereby diversely aggregated into nebulæ, to be thenceforth evolved into systems of suns and planets. Of course, the pericosm rotates only as instigated by creative power, just as in the said experiment the apposite fluid moves only as it is moved by the hand of the experimenter. The similitude of art and nature in this light is perfect. Yet there is a flaw in Mr. Spencer's apprehension of it, or rather of its significance; and now let us see in what that consists. Recurring to the foregoing extract from his essay, we find it in the gist of this sentence:

"Thus, given the original nebula, which, acquiring vortical motion in the way we have explained, has at length concentrated into a vast spheroid of aëriform matter moving round its axis—*given this*, and mechanical principles explain *the rest.*"

I have italicized two phrases in this sentence as worthy of the reader's special attention. It is obvious that the phrase "*given this*" as there employed comprises all that goes before it, namely, the origin of nebulæ and the genesis of nebular rotation; so that, in Mr. Spencer's judgment, "*the rest*" which he thinks mechanical principles suffice to explain, represents only that part of cosmic evolution which follows nebular rotation. With no broader application than that, his remark that "*a priori* reasoning harmonizes with the results of experiment" is almost inconsequential, since the nebular hypothesis so far as evolved by Laplace and his disciples, though largely due to *a priori* reasoning, is scientifically unassailable. Mr. Spencer was aware, when writing his restricted estimate of what the Plateau experiment is apt to elucidate, that it is wholly inapplicable to *his a priori* reasoning as to the competence of gravity, aided by thermal and other chemical principles, to induce nebular rotation; and this is why he claimed its favor only for those mechanical elements of the nebular hypothesis which are typified by the experiment, and did not claim that it favors *his* speculation as to how nebular rotation obtained. Nevertheless, while the experiment represents only mechanical principles, its purport parallels the whole process of cosmic evolution; and to limit its analogy to that part thereof which follows nebular rotation, is to throw away all that the Plateau experiment is good for. For the nebular parentage of the Solar System is indisputable: this deduction of *a priori* reasoning needs no confirmation by experiment beyond what astronomic observation has already supplied. It is the rationale of *cosmic* evolution *in toto*, of the genesis of nebular rotation and of the process whereby nebulæ themselves are generated, that constitutes the emergent problem of synthetic physical science now transpiring; and the special use imputable to the Plateau experiment is its tendency to confirm the most rational conception of cosmoplastic agency which has as yet been suggested by scientific research. It has no bearing upon Mr. Spencer's argument of kindred intent, because the elements of the two are not congeneric. The experiment involves no change of temperature nor chemical action in any form, and has no types of flocculi, all which items are made essential to the genesis of nebular rotation according to its tentative explication by Mr. Spencer. This he did not presume to have maintained otherwise than hypothetically. It was proposed as a supplement to Laplace's theory, but not as complementing "the Nebular Hypothesis." It comprehended a part only, though a very considerable part, of what Mr. Spencer designated by the phrase "*Given this,*" so much of which as was original with him being germane to the genesis of nebular rotation, apart from the formation of nebulæ, concerning which he propounded nothing. The theory thus discriminated has been properly summarized by a contributor to Alden's edition of *Chambers's Encylopedia,*representing the drift of Mr. Spencer's argument. In the intricate statement reproduced below, the reader will see how difficult it is to account for the rotation of the Solar Nebula as the precursor of planetary motion, without postulating the inherent rotation of the whole stellar system, or recognizing the vehicular motion of Matter.

"It is assumed by some that on physical principles primordial matter widely distributed through space would pass through the following changes. Gravitation would cause the mass to contract and become more dense: this would be followed by atomic repulsion, which, acting against gravitation, would produce heat. After a certain degree of condensation had taken place, molecular combination would result, which would again cause a great evolution of heat: this would be followed by radiation and precipitation of binary atoms as flocculi floating in a rarer medium: these flocculi will tend to move toward a common centre: this will result in a spiral movement" whence will ensue the rotation of the whole rarer medium in which the flocculi are floating.

That is what the encyclopedist says "is assumed by some" speculative rather than scientific inquirers.

It is, moreover, as good a theory of nebular rotation as is to be found in any treatise on the subject. It is, in fact, the only purported explication thereof to which scientists have as yet lent an ear with even partial assent. The Pericosmic Theory claims to be its first and sole prospective rival. Before contrasting the two, however, it would seem but just to state the former in the terms of its original propounder.

Mr. Spencer's exposition of the way certain physical principles may be supposed to conspire with competence to generate nebular rotation, is contained in the following extract from his essay on *the Nebular Hypothesis.*

"Given a rare and widely-diffused mass of nebulous matter, having a diameter, say as great as the distance from the Sun to Sirius, what are the successive changes that will take place in it? Mutual gravitation will approximate its atoms; but their approximation will be opposed by atomic repulsion, the overcoming of which implies the evolution of heat. As fast as this heat partially escapes by radiation, further approximation will take place, attended by further evolution of heat, and so on continuously: the processes not occurring separately as here described, but simultaneously, uninterruptedly, and with increasing activity. Eventually, this slow movement of the atoms towards their common center of gravity, will bring about phenomena of another order.

"Arguing from the known laws of atomic combination, it will happen that when the nebulous mass has reached a particular stage of condensation—when its internally-situated atoms have approached to within certain distances, have generated a certain amount of heat, and are subjected to a certain mutual pressure (the heat and pressure both increasing as the aggregation progresses); some of them will suddenly enter into chemical union. Whether the binary atoms so produced be of kinds such as we know, which is possible; or whether they be of kinds simpler than we know, which is more probable; matters not to the argument. It suffices that molecular combination of some species will finally take place. When it does take place, it will be accompanied by a great and sudden disengagement of heat; and until this excess of heat has escaped, the newly-formed binary atoms will remain uniformly diffused, or, as it were, dissolved in the pre-existing nebulous medium.

"But now mark what must by-and-by happen. When radiation has adequately lowered the temperature, these binary atoms will precipitate; and having precipitated, they will not remain uniformly diffused, but will aggregate into *flocculi:* just as water, when precipitated from air, collects into clouds. This *a priori* conclusion is confirmed by the observation of those still extant portions of nebulous matter which constitutes comets; for "that the luminous part of a comet is something in the nature of a smoke, fog, or cloud, suspended in a transparent atmosphere, is evident," says Sir John Herschel.

"Concluding, then, that a nebulous mass will, in course of time, resolve itself into flocculi of precipitated denser matter, floating in the rarer medium from which they were precipitated, let us inquire what will be the mechanical results. We shall find that they will be quite different from those occurring in the original homogeneous mass; and also quite different from those which would occur among discrete masses dispersed through empty space. Bodies dispersed through empty space, would move in straight lines towards their common center of gravity. So, too, would bodies dispersed through a resisting medium, provided they were spherical, or of forms presenting symmetrical faces to their lines of movement. But *irregular* bodies dispersed through a resisting medium, will *not* move in straight lines towards their common center of gravity. A mass which presents an irregular face to its line of movement through a resisting medium, must necessarily be deflected from its original course, by the unequal re-actions of the medium on its different sides. Hence each *flocculus*, as by analogy we term one of these precipitated masses of gas or vapor, will acquire a movement, not towards the common center of gravity, but towards one or the other side of it; and this oblique movement, accelerated as well as changed in direction by the increasing centripetal force, but retarded by the resisting medium, will result in a spiral, ending in the common center of gravity. Observe, however, that this conclusion, valid as far as it goes, by no means proves a common spiral movement of all the flocculi; for as they must not only be varied in their forms, but disposed in all varieties of position, their respective movements will be deflected, not towards one side of the common center of gravity, but towards various sides. How then can there result a spiral movement common to them all? Very simply. Each flocculus, in describing its spiral course, must give motion to the rarer medium through which it is moving.

"Now, the probabilities are infinity to one against all the respective motions thus impressed on this rarer medium, exactly balancing each other. And if they do not balance each other, the inevitable result must be a rotation of the whole mass of the rarer medium in one direction. But preponderating momentum in one direction, having caused rotation of the medium in that direction, the rotating medium must in turn gradually arrest such flocculi as are moving in opposition, and impress its own motion upon them; and thus there will ultimately be formed a rotating medium with suspended flocculi partaking of its motion, while they move in converging spirals towards the common center of gravity."

The theory set forth above was published some 30 years ago, and it may be that its famed author does not hold every point of it in the same light to-day.

For sake of the argument, let us admit its general truth, excepting only the deduction imbodied in the last paragraph. The leading fallacy of that consists with the tacit assumption that the said *flocculi* the irregular forms of which are (*ex hypothesi*) essential to the alleged mode of generating nebular rotation, are *permanently* irregular; whereas, in effect of gravity in the substance thereof, they must in time become spherical, when, as Mr. Spencer says, "they would move in straight lines towards their common center of gravity," with no rotative influence upon the medium of their suspension. Therefore, instead of the *flocculi* begetting the rotation of their supposed medium, to be themselves in turn arrested from diverse declivities thereby, it is more likely that the uncertain predominance of either sway of such correlative resistance would preponderate in concurrence with the bent of gravity to effect their early conglobation. It will suffice, so far as is relevant to the present object of discussion, to probe this vital constituent of Mr. Spencer's theory.

As to the assertion that "each *flocculus* in describing its spiral course, must give motion to the rarer medium in which it is moving," it is inadequate as a premise for Mr. Spencer's inference. It is fathered by no scientific estimate of its motoric quantity. A *flocculus* might give motion to its medium, but how much? Mr. Spencer seems not to have asked himself what measure of *vis viva* would be generated by the vaguely described process, and how far that must come short of what would be requisite to induce the rotation of that imbodiment of static force whose inertia balances the collective motivity of all its gravitating contents, the main portion of which tends only to perpetuate the non-rotation of their common vehicle.

Think of a vast motionless globe of nebulous matter consisting mainly of isolated atoms whose collective bulk is freighted with innumerable vaporous bodies like rainless clouds in a summer sky. Having never rotated, it has no equator, no axis, no polar hemispheres. It is waiting for an impetus to rotate, such as the differential gravitation of those vaporous bodies, now suspended like blebs of oil in water or clouds in air, are going to generate in their medium, by virtue of their irregular shapes and the consequent obliquitous trend of their gravitation toward the center of their medium. Perhaps no two of those *flocculi* (as those vaporous bodies are called for their resemblance to fleeces of wool) are equal in volume or quite homologous in form, and therefore no two of them are likely to gravitate in precisely the same direction from any given point of their diverse localities; the trend of their gravitation depending as much on their difference of position as on their irregular configuration. The larger will deviate less from a right line towards their common center than the smaller, which will also swerve toward the larger in proportion to correlative difference of mass. Each and all are subject to gravity which is bent upon their conglomeration in two senses of the word as suggested by the adjectives *separate* and *aggregate;* the process of their integral aggregation being slower than that of their conglobation. Under these conditions, the *flocculi* as subject to the process of integral gravitation are supposed to be deflected from their legitimate course, away from the goal of gravity to some lateral part of their medium; and this in virtue of their irregular shapes and diverse starting-points complicated with irresistible resistance of the tenuous medium which alone prevents their immediate conglomeration: wherein, nevertheless, they are expected to generate a superior force of sufficient cogency to overcome the older bent of their medium to stay their gravitation. The alleged issue is quite obscure. It might seem possible, but hardly probable, that it should follow the diuternal augmentation of gravity in accord with the slow but persistent condensation of a nebula, *if* the *flocculi* were bound to retain coëvally their irregular forms. But they are not. On the contrary, they are metamorphic, and tend constantly to become spherical. This item of the problem Mr. Spencer seems not to have recollected when he remarked, as a context of his induction, that "spherical bodies dispersed through a resisting medium would move in straight lines towards their common center of gravity." Now, according to well-known physical principles, all *flocculi*, however angular may be their incidental formation, begin at once thenceforth to conglobate, and from this predicament it follows that their alleged irregular forms are transitional and comparatively ephemeral. It is obvious that any special trend of their diversified motion imputable to their competitive failure to balance each other as motors, must be exceedingly small. As compared with the inertia of their vehicle which it is expected to overcome, it is infinitesimal. How long, till, by favor of the augmenting translatory gravitation of its special *floccular* imbodiment, its momentum shall wax potent enough to sway the whole medium which now impedes the collective bent of its class? Longer, far longer, than gravity requires to round each *flocculus*, as it must in time to frustrate the integral motivity of any number of *flocculi*, the trend of whose obliquitous gravitation may chance to coincide, dependent as that is upon their evanecent angular shapes.

After all, the fallacy of Mr. Spencer's induction, or of any other speculative reasoning in undemonstrative defense of cosmic evolution, proves nothing and signifies nothing against the truth of the nebular hypothesis, as a partial outline of cosmology. His essay, in the main, is not only irrefutable, but, with the single exception pointed out, successful and singularly (as well as signally) edifying to scientific inquirers. His only considerable mistake in dealing with the subject is fathomed by the one sentence analyzed above, or rather by the symbol of its provisory clause, "*given this*"—a nebula already indued with vortical or spiral motion in its substance, or its equivalent as an inherent impetus to rotation. Instead of that he should have said, as I now say, *Given the pericosm as the receptacle of Matter*; or more specifically, Given the sphere of pericosmic Ether, as an atom of concentric force, impleted with its infinitesimal homologues in isolated diffusion, that indued with inherent rotation and these differentially motoric and motile; and scientifically-revealed principles will account for all the subsequent operations of physical Nature. It is *a priori* reasoning to this cosmologic effect which may be said to harmonize with experiment, not merely in the restricted sense of Mr. Spencer's thought when comparing the Plateau experiment with the sequel of nebular rotation. It is not "the genesis of a solar system," but the birth of nebulæ—the evolution of the mundane system, which the said experiment simulates. The analogism which it warrants is world-wide. In the absence of direct and immediately-relevant information, it is appreciable as collateral evidence. But the pericosmic theory needs not its support. More conclusive is the deduction of all astronomic phenomena from the postulated rotation of the whole physical world, as none of them has been found otherwise scientifically explicable.

Thus the question which makes the subject of this chapter is answered. The rationale of planetary rotation propounded above concurs with that of nebular rotation previously given (inasmuch as they are analogous by dependence upon one and the same genetic agency), in a way to complement and verify the well-founded "Nebular Hypothesis," which has been accepted heretofore as too reasonable for dissent, though wanting demonstration; but, as supplemented by recent advances of physical science, it now claims affiliation by *the Pericosmic Theory*, whereby, it is of consequence to add, and as the scientific world cannot be slow to perceive, astronomy is made tributary to cosmology in a higher sense than were possible without the intelligence which this comprehensive theory mediates.

To re-enforce the merits of the question, I repeat its formula: *What validates the Nebular Hypothesis?* That only which complements it, by supplying its essential pre-requisite, namely: the two supra-material factors of cosmic evolution, and their identical *nidus*. Laplace's theory has been deemed hypothetical hitherto merely because its advocates have failed to elucidate, to scientific satisfaction, the primordial parentage and superinduced rotation of nebulæ, or to postulate the physical mainspring of cosmoplastic energy. This desideratum is compassed at length by the Pericosmic Theory, which demonstrates, by mathematical induction from astronomic data, that the medium of light is also the agent of matter's gravitation and translatory motion; the one being due to the Ether's pressure on its material contents, and the other to the inherent rotation of its volume.

Thus, the Nebular Hypothesis is validated by the discovery that it is germane to the Pericosmic Theory, which itself is justified by its accord with all known principles of Nature and its consequent relevance to the explication of all natural phenomena.

In proportion as the novel intelligence here brought to light becomes conventional, there will be less talk about "the Nebular Hypothesis" and more attention to the minor problems of cosmic evolution; and prospective cosmologists will regard the taking speculations of Laplace and his compeers as the virtual preamble to the Pericosmic Theory.

CHAPTER XIII.

SCOPE AND TEST OF THE PERICOSMIC THEORY.

Having identified the capital theme of this essay with the consummated "*Nebular Hypothesis*," it remains to demonstrate its aptness to affiliate all the physical sciences, to which it relates as the trunk to the branches of a tree.

The cardinal elements of the Pericosmic Theory are yet to be rationally cognized as co-essential attributes of a logical whole, none of which may be rejected without rejecting the theory itself, nor properly conceived without assenting to its integral truth. Briefly designated, they are—

1. Biune structure of the physical world; the Ether a fast receptacle of Matter.

2. *Concentric Force* with an esoteric base the stuff of atoms, whence springs elasticity with all the reactive forces of Nature.

3. That the luminiferous ether is a pericosmic atom—an indivisible unit of concentric force, whence spring all the centripetal motions in Nature.

4. Inherent rotation of the pericosm and conse-

quent vehicular motion of its material contents, whence spring all the centrifugal motions in Nature.

5. Inherent rotation of atoms as constituents of certain elements of overt matter, well-exemplified by those of oxygen and of hydrogen, whence springs their susceptibility to metamorphosis as well as to variation in peripheral magnitude.

6. That the pericosm is the agent of gravity, momentum, and chemical action, as well as the medium of light, electricity, heat, sound, color, etc., though of light only apart from matter, after inception.

7. That the rotation of the Solar Nebula was induced by the concentric gravitation of its substance and coincident shortening of the radius of its vehicular motion, a cumulative surplus of the momentum of which was thus commuted to the rotary motion of its volume.

8. That the orbital motion of each primary planet is due to the translated momentum of the Solar Nebula's rotary motion.

9. That the rotary motion of each primary planet of the solar system was superinduced upon its orbital motion by transmutation of its vehicular motion according to the diametric difference of both this and that.

10. That the suborbital motion of each satellite of a primary planet is equal to the rotary motion of its parent planet at the epoch of parturition.

11. That the rotation of each satellite of a class was superinduced upon its suborbital motion by

transmutation of its vehicular motion according to the diametric difference of both this and that.

12. That the Sun and all the *solar* orbs which glitter in the sky of a cloudless night are stationary in relation to each other, having no other motion in space than what is identified with the rotation of their common vehicle.

These twelve propositions are co-ordinately essential to the rationale of the foreshown theorem of planetary rotation, as well as of that according to which the rotation of the Solar Nebula obtained. As elements of the Pericosmic Theory, they are not only compatible each with all, but their purport is indiscerptibly compositive. The truth of each is antecedent to their collective truth, and this is to be identified with their commutual dependence. If one of the twelve propositions could be disproved, then none of its correlatives would be true: so to demonstrate any one of them is to vindicate the truth of their compositive import. This is the rationale of all astronomic phenomena, the most considerable class of which is designated by the theorem of planetary rotation announced at the beginning of Chapter X., that being otherwise verified, to wit: by mathematical induction from telescopic data. By its fitness to account for these, the Pericosmic Theory is adjudged to be valid, not merely according to the *maxim* that "the justification of a theory consists in its exclusive competence to account for phenomena," *but, more surely, according to the *axiom* that the truth of a theory is evinced by its aptness to explain *all* the phenomena of the category any one of which it is meant to explain, without a fetch of unwarranted assumption. The *maxim* is, indeed, not an infallible index to truthful conception, as appears in the case of Kepler's invention of ellipsoidal orbits to account for the varying orbital motion of planets, with no attempt to show why they should not move in perfect circles, as according to the Pericosmic Theory they do, while the variant velocity of their respective orbital motions is due, not to the varying distance of a planet from the Sun, but to its vehicular motion; this assumption being warranted by its aptness to account for *all* the multifarious phenomena of the category *this one* of which it is meant to explain.

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*Tyndall.

The Pericosmic Theory affords the unique rationale of planetary rotation as expounded in chapters X. and XI. There has been no scientific attempt to solve the problem heretofore. Has anybody ever asked *why* planets rotate? The question has found no place in any astronomic treatise that I have read. In all works on popular science, so far as I am informed, the fact of planetary rotation is recognized without research for its physical cause. But in chapter IX. of this essay the question is put in earnest, and answered consecutively; with what effect appears in the context of its original announcement. Therein it is stated, and maintained inductively, that planetary rotation is induced by two motoric factors, namely: the diametric difference of a planet's vehicular motion and the diametric difference of its orbital motion, conjointly; either of these two factors alone being inoperative. But here another question emerges: How comes a planet to have vehicular motion? and the only answer is, Because it has a vehicle which itself has inherent motion; that is to say, a vehicle which rotates (proposition 4), since vehicular motion other than curvilinear would be inept. But such a vehicle must contain all Matter, and therefore cannot itself be material, though it must be substantial (proposition 1). In this way it is certified that the Ether is not a species of Matter, as many scientists have fancied, though it may be essentially of the same primigenous stuff as that of the ultimate constituents of Matter. Does anybody (save its Maker) know what that is? All chemists agree as to the atomic consistence of matter; but none of them has as yet replied to the question put many years ago by an eminent physicist,* as to the prime stuff of atoms —"atoms of what?" They are certainly made of something substantial; and until we know more definitely than is signified by calling that something *concentric force* (proposition 2), we must be content with this provisional term, which, inadequate as it is, serves well its purpose to designate the substratum both of the luminiferous Ether and of Matter (proposition 3), atoms in all cases differing essentially only as magnate and minute. In fact, that is the only available answer to the question as to the make of *body* in the largest acceptation of the word as the base of motion, inertia, and physical being, the nature

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**The Unseen Universe.*

of which is known, or may be knowable, only by inference from its behavior. The extreme rapidity of light proves both the transcendent elasticity and the indivisible continuity of its medium, such as entitles it to be called *an atom of concentric force*, differing only in magnitude from the minute components of overt matter, whose rebound from collision betrays their ethereal attributes. The pith of physical substance is the pedestal of mundane existence. See herein the fact that the Pericosmic Theory has the same footing as all branches of natural science.

The rationale of planetary rotation is to be found by probing the four simple ratios of compound proportion which the theorem of its physical cause enjoins. This is best effected by the device of question and answer.

Question 1. *Why is a planet's rotary motion proportional to the diameter of its volume?*

Answer. Because this is the measure of either of the two equal factors of the prime impetus thereto designated in the preceding paragraph. Both these factors of planetary rotation are traductive, one mediately and the other immediately, from the rotary motion of the whole receptacle of Matter, which, by implication, embraces all the elements of the Pericosmic Theory as represented by the twelve forestated propositions. Now, the astronomic truth, that the rotary motion of a new-born planet has been in all cases, so far as inquest has been effective, proportional to the diameter of its pristine volume, is demonstrated in chapters IX., X. and XI., by induction from the extant motions of the oldest satellite respectively of the Earth, Jupiter, Saturn, and Uranus, which, as well as all analogous phenomena in the physical world, the Pericosmic Theory is exclusively competent to explain. Moreover, the rotation of the pericosm is otherwise diversely indicated, as (*a*) by the visible shape of the Galaxy, (*b*) by the varying orbital motion of each planetary member of the solar system, (*c*) by its relevance, as the co-agent of gravity, to the genesis of nebular rotation, and especially (*d*) by its function as the only conceivable mode of Matter's vehicular motion, which proves to be as indispensable to cosmic evolution as gravity or its dynamic compeer.

Question 2. *Why is a planet's rotary motion inversely proportional to the inclination of its equator to its orbit?*

Answer. Because such inclination is equivalent to a diminution of a planet's diameter, and so of the factors of its rotary motion.

Question 3. *Why is a planet's rotary motion proportional to the diameter of its orbit?*

Answer. Because the larger its orbit the greater its distance from the Sun, and so the less its solar gravity, which is obstructive to planetary rotation. How and wherefore it is obstructive will appear in answer to the next question.

Question 4. *Why is a planet's rotary motion virtually proportional to its orbital motion?*

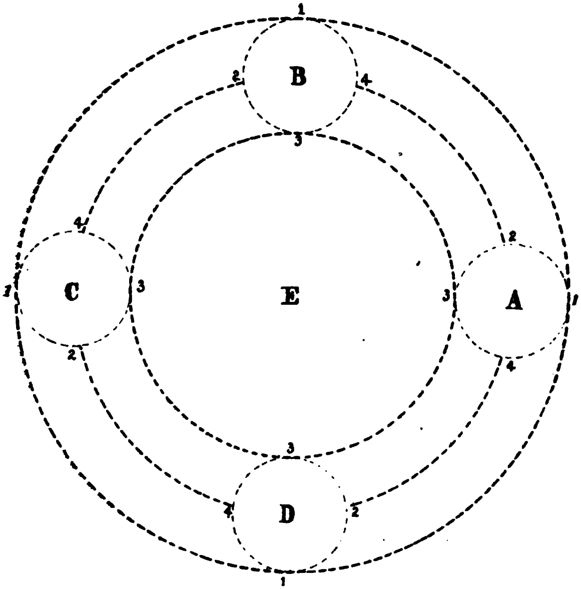
Answer. Because that is superinduced upon this in the sense that one of the factors thereof is generated and the other made effective by the planet's motion in a curve, while its orbital motion is equivalent to the rotary motion of its nebular antecedent (propositions 8 and 10), whose motoric quantum was inversely proportional to the dimensions of its equator, which was synchronally commensurate with the planet's orbit. More directly, because the orbital motion of a planet lessens its solar gravity, and so negatively favors planetary rotation.

The Earth's solar gravity is 83 times as great as that of the Moon. But the Moon's solar gravity is much less than its geoselenic gravity, as is shown by the fact that it revolves round the Earth 13 times as often as round the Sun. The Earth, when it gave birth to the Moon, rotated in less time than when itself was born; and wherefore? Because its equator was lessened by gravitative condensation of its volume; and subsequently though its integral solar gravity has been constant in quantity from first to last, its equator was continuously diminished down to the epoch of the Earth's superficial solidification, when for the first time it turned on its axis 365 times in a year.

If a new-born planet were posited so near the Sun that the diametric difference of its vehicular motion should not exceed that of its solar gravity, then of course the diametric difference of its orbital motion would not exceed that of its centrifugal bent, and so, the ratio of its orbital motion to its rotary motion being in that case precisely that of its orbit to its equator, the planet itself would rotate but once during its orbital period. Such was the predicament of the Moon at its birth, when the two factors of its rotary motion were virtually equal to the two factors of its orbital motion, making the axis of that coincident with the Moon's suborbital center, or the center of geoselenic gravity. In the strict sense of the word, the Moon does not, and never did, *rotate*, but in relation to the Earth its attitude is perpetually statuesque. Why? Because, though the two factors of its semi-rotative impetus obtained primarily, the momentum of each was forestalled, one by the diametric difference of geoselenic gravity, the other by that of lunar centrifugation. The subjoined diagram elucidates this statement, showing that the Moon simulates rotation only by revolving round the center of its terrestrial orbit without regard to its own center of gravity.

Let the four circles, *A*, *B*, *C*, *D*, and the three larger circles, one of which bisects the smaller, represent the Moon in equidistant parts of its suborbit, with the Earth near its center; and let the figures 1, 2, 3, 4 denote fixed points in the Moon's equator, the letters therein denoting corresponding fixed points in the lunar suborbit. It is evident on inspection that the Moon in passing round the Earth conserves the physical identity of its inner and outer hemispheres, as well as their relative distance from its parent; that the vertex of the inner hemisphere denoted by 3, and the vertex of the outer hemisphere denoted by

DIAGRAM IV.



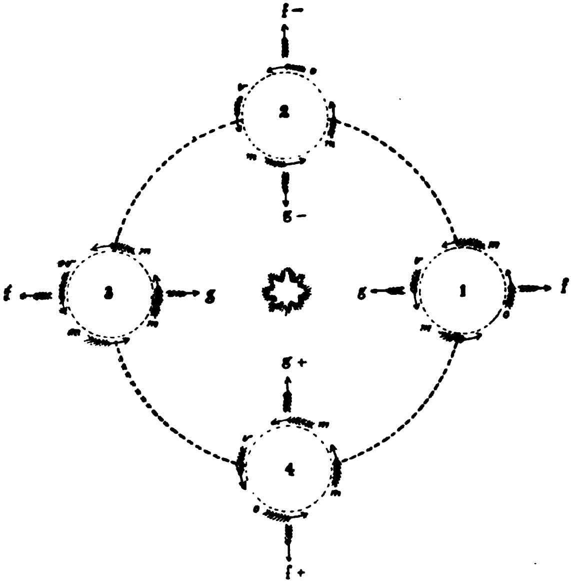
1, are respectively the same in each quadrature of a lunation, the Moon's diameter always coinciding with the diameter of its suborbit, as *E*-3-*A*-1, *E*-3-*B*-1, *E*-3-*C*-1, *E*-3-*D*-1; which fact demonstrates that the Moon has no axis of rotation other than that of its suborbital motion. And *why* so? The answer is given above, but may be stated in other terms. The two factors of the new-born Moon's rotary motion were hemispherically antagonized and extenuated to half their dynamic value by geoselenic gravity, the diametric difference of which was equal to either that of the Moon's suborbital motion or of its vehicular motion; the effect being the same as if the latter had been extinguished and the former had operated exclusively; so that the vertex of the Moon's outer hemisphere moved as much faster than its equatorial axis as the vertex of its inner hemisphere moved slower than its equatorial axis, whose translatory motion was primarily, and still is, 54,916 miles a day. That is to say, the vertex of the Moon's outer hemisphere moved 56,926 miles a day, while the vertex of its inner hemisphere moved but 52,906 miles a day; and only by means of this hemispheric difference of locomotion was the Moon's virtual rotation effected. But the diametric difference of the new-born Earth's solar gravity was counteracted by the two factors of its orbital motion in the ratio of 1692922 to 54916 = 30·9 days, so that the primal Earth rotated but about 11·82 times during its orbital period, which was the same then as now, and 365·2563 ÷ 30·9 = 11·82.

The Moon represents not integral but partial rotation: it turns, not on its own, but on a foreign, axis. It is a law of planetary rotation as exemplified by all primary planets, that its period shortens proportionally to the condensation of its volume. The Moon's extant equator is less than one-eighth of its primal dimension, and therefore if its nominal rotation were axial in the same sense as is predicable of primary planets, the period thereof should have been shortened from 27·321 to less than 7 days; just as that of the Earth, because of the condensation of its volume, has been shortened faom 30.9 days to a single day. The fact that the Moon simulates rotation as tardily now as at the epoch of its birth, when its diameter was 8 times as large, refutes the notion of its rotating at all in the proper acceptation of the term. It does not turn on *its* axis, but on the antiquated axis of its terrestrial antecedent — that of the Earth when about to let go an eloping rim of its equator, as germ of the Moon.

The diameter of the new-born Earth was 30·9 times as great as that of the new-born Moon, and so the diametric difference of the new-born Earth's vehicular motion, as well as of its orbital motion, was 30·9 times as great as the corresponding attributes of the new-born Moon. The ratio of the new-born Moon's suborbit to its equator was precisely that of its suborbital motion to its rotary motion ; but the ratio of the new-born Earth's orbit to its equator was 11·82 times that of its orbital motion to its rotary motion. Accordingly, in the case of the new-born Moon, the diametric difference of its geoselenic gravity was equal to either factor of the Moon's partial rotation ; whereas, in the case of the new-born Earth, each factor of its rotary motion was 11·82 times as great as the diametric difference of the Earth's solar gravity ; and though this was 30·9 times as great as the Moon's prime measure of geoselenic gravity, it was completely counteracted by the centrifugal bent of the Earth's greater orbital motion.

The incentive and governing principles of planetary rotation are aptly illustrated by the following diagram, which, however, requires a few words of explication.

DIAGRAM V.



Let the large circle in this diagram be the Earth's orbit with the Sun slightly excentric therein, and the four small circles the new-born Earth in the four cardinal attitudes of its relation to the Sun, whose planets move in the order of the numerals 1, 2, 3, 4. *Positus* 1 of the Earth's solar attitudes corresponds to the vernal equinox; 2, to the summer solstice; 3, to the autumnal equinox; and 4, to the winter solstice. The vehicular motion of both the Earth and Sun trends always as indicated by the sagittal symbol of *v* in all its local positions, though only for the nick of time it occupies either of two opposite points in its orbit—the solstitial points—that of the Earth coincides in velocity with that of the Sun. From the summer solstice to the winter solstice—from 2 to 4—the Earth's vehicular motion is greater than that of the Sun, and the maximum of this excess obtains at the autumnal equinox (*positus* 3). *Per contra*, from the winter solstice to the summer solstice—from 4 to 2—the Sun's vehicular motion exceeds that of the Earth as greatly as in the other attitude it was exceeded by that of the Earth, and the maximum of *this* excess, or the minimum of the Earth's vehicular motion, obtains at the vernal equinox (*positus* 1). The Sun's vehicular motion is unvarying; whereas that of the Earth is ever-variant. Yet their annual quantum thereof is equal, what the Earth gains in one half its orbit being lost in the other half. The measure of this quantum is unknown. But the sagittal symbol *v* denotes a definite quantity—the *diametric difference* of the Earth's vehicular motion, which is demonstrably 54,916 miles *per diem*. Of course, the *diametric difference* of the Earth's orbital motion as the compeer of that is its motific equivalent, and being antithetic in position and trend, the virtual twain constitute a planet's semi-rotative impetus, whose momentum completes its rotation, as indicated by the array of arrows (*o*, *m*, *v*, *m*) around the minor circle 1.

The orbital motion of the Earth's axis is, and has always been from the day of the planet's birth, 1572820 miles a day, while that of the perihelion point of its prime equator was 54,916 miles a day less and that of its apohelion point 54,916 miles a day more, making one rotation in 30·9 days and 11·82 rotations in a year; the day in this statement being the current solar day.

At the vernal equinox *o* and *v* are opposite; but at the autumnal equinox they conjoin at the point in the Earth's equator most distant from the Sun, when the diametric difference of the Earth's vehicular motion is twice as great as at the vernal equinox, but with this drawback: at 1, the Sun's vehicular motion is opposite to the Earth's orbital motion; whereas at 3, the Sun's vehicular motion copes with the Earth's orbital motion. In the one case, the Sun's vehicular motion is virtually added to the Earth's, or this is added to the Earth's orbital motion, and in the other case it is virtually subtracted from the Earth's orbital motion, or from the sum of $o+v$; so that in effect there is no durable change in either of the Earth's alternate habitudes.

At 2, and at 4, *o* and *v* are at a right angle to each other, and opposite to their respective momentum (*m*).

The symbols *g* and *f* stand for the two antithetic forces—the centripetal and the centrifugal—which in circular motion are always equipollent, yet in orbital motion ever-variant *per se*, waxing in concord with the planet's incremental velocity from its minimum at the summer solstice to its maximum at the winter solstice, and then waning simultaneously from their maximum at *positus* 4 to their minimum at *positus* 2, as distinctively signified by the suffixes + and —.

The axis of the rotating pericosm, and so of the Earth and Sun's vehicular motion, is far away on the right of circle 1.

During the process of a planet's evolution from its natal annular to its ultimate globular form, there is no diametric difference of its solar gravity, which persists equably throughout its material base; so that, at the nick of globation, the vertex of a nascent planet's inner hemisphere moves incipiently with the same velocity and trend as that of its outer hemisphere, that is tangentially to its orbit. Then the diametric difference of a new-born planet's solar gravity is countervailed by that of its centrifugal bent, these two forces being in circular motion always equal and opposite. It is the *integral* solar gravity of a planet whose function is signally effective in planetary motion, whereby the planet is continuously pushed toward the Sun; and were it subject to no other but this and the projectile, it would seem to rotate retrogressively. Its apparent backword rotation was in fact supplanted by the diametric difference of the new-born Moon's vehicular motion, which, tallying antithetically with the marginal difference of its terrestrial orbit, was just sufficient to turn the Moon forward on the axis of its geoselenic rotation, or rotation of the Earth at the time it gave birth to the Moon, to the momentum of which the Moon's suborbital motion is exclusively due. There is no other reason for the coincidence of the Moon's rotary and suborbital periods than that which is outlined above.

Question 5. *Why does the theorem of planetary rotation announced in chapter X. apply to the elements of a primary planet only by means of its oldest satellite.*

Answer. Because it is the first-born satellite only whose suborbit is approximately equal to the equator of a new-born planet, which is an immediate offspring of the Solar Nebula. At the birth of a primary planet's second offspring, not only has its equator been largely diminished, shortening the period of its rotation, but its rotary motion has been increased by alternate expansion and contraction of its volume as described of the Solar Nebula in chapter VI.

Question 6. *How and wherefore the genesis of planetary rotation differs from that of nebular rotation.*

Answer. The two processes differ only by one feature, two features thereof being analogous ; nebular rotation obtaining according to proposition 7 and planetary rotation according to proposition 9. Both nebulæ and planets are alike subject to the ether's pressure whereby their volumes are condensed and their equators lessened, thus shortening the periods of their rotation by narrowing its motoric compass without quickening its velocity or contributing aught to that species of motion which is induced solely by the rotation of their common vehicle. But though the rotary motion in such cases is not increased *per se*, or in itself considered, its translocation from the equator toward the axis of an inceptively-rotating nebula or planet does beget a concentric increase of motion in the substance thereof, in effect of which new-born nebulæ and planets are alike subject to equatorial expansion resulting in the formation of revolving rings, which they let go with reluctance and then relapse perforce, charged with the momentum thereof, by which means their rotary motion is at intervals considerably enhanced. Thus far, and no farther, the genesis of nebular rotation and subsequent increment thereof are analogous to the genesis and subsequent increment of planetary rotation.

But the latter process is signalized by a third feature which is utterly foreign to the former, namely: a planet's hemispheric subjection to two antithetic forces which constitute the supreme factors of its rotary motion, to wit: the diametric difference of its vehicular motion and the diametric difference of its orbital motion, which are commensurate and co-existent for the nonce, neither obtaining functionally without its colleague, and both ensuing from planetary motion, that is motion in an orbit. But the Solar Nebula had no orbit nor orbital motion (proposition 12). This fact, though never before recognized in astronomic science, is easily demonstrated.

If the Solar Nebula had moved in an orbit and begun to rotate at the birth of its youngest offspring, its velocity of rotation would have been threefold greater than it was as indicated by Mercury's orbital motion. Its diameter being 131 times as great as that of the new-born Earth, the diametric difference of its vehicular and orbital motions combined would have been virtually equal to 54,916×131=7,193,996 miles a day; and the orbit of Mercury divided by this number shows that the Solar Nebula in that predicament would have rotated in 30·9 days instead of 87·969 days as it did. In the light of superficial inquiry this result does not seem wonderful. But if we make a similar calculation pertinent to any earlier epoch in the history of the solar system the induction will be more striking. If the rotation of the Solar Nebula had first obtained at the time it gave birth to our planet, and had its genesis been homologous with that of planetary rotation, since the diameter of its volume was 338·5 times as great as that of the new-born Earth, the velocity thereof must have been proportionally rapid, to wit: 18,591,000 miles a day, making a complete rotation in 30.9 days. It is certain, however, that the rotary motion of the Solar Nebula was incremental from the birth of Neptune to that of Mercury; that at the epoch of its first parturition it was rotating at the rate of 286,983 miles a day; and there is no reason for imagining the inception of its rotation at a later epoch than that of its conglobation, when, if it had obtained in the same way that planets are induced to rotate, its rotary motion would have exceeded a billion miles a day, as shown below.

$$51318837866\times 2=10263675732\div 540146=19001{\cdot}669.$$

$$\frac{10263675732\times 3{\cdot}1416=32244363683}{19001{\cdot}669\times 54916=1043495654}=30{\cdot}9$$

That is to say, if the Solar Nebula had moved in an orbit at the time of its conglobation, its period of rotation would have been 30·9 days instead of 420 years, as discovered in chapter VII.

According to M. Mädler's theory of stellar-orbital motion, our Sun with its retinue of planets moves in an orbit whose radius is 34 million times as great as the radius of the Earth's orbit, or 3 quadrillion, 108 trillion, 673 billion, 40 million miles, and whose center is occupied by the star Alcyone of the Pleiades as the nebular parent of the Galaxy. The supposed orbit itself would measure 19 quadrillion, 532 trillion, 414 billion, 928 million miles. The Sun, moving in this orbit (according to Mädler) 8 miles a second, or 691,200 miles a day, would make one revolution round the alleged central sun in 77 million, 92 thousand and 981 years.

Now it is scientifically ascertained that the Solar Nebula when conglobated was already rotating at the slow rate of 209,937 miles a day; this measure of rotary motion being the resultant of the spiral motion of its matter during its diuternal aggregation from a limited portion of its environing space. There is no way to reconcile Mädler's theory with this astronomic fact but to imagine that the mass of Alcoyne is 4,549,300,000 times as great as that of our Sun, as is found by the mathematical process here presented.

The Earth and the Solar Nebula.

$$\left.\begin{array}{lrcl} (a) & 270 & : & 5{,}131{,}837 \\ (b) & 1 & : & 34{,}000{,}000 \\ & x & : & 1 \\ (c) & 1572 & : & 691 \\ (d) & 84 & : & 5\cdot1428 \end{array}\right\} : : 54{,}916 : 209{,}937.$$

Therefore, conversely, the product of the means of the given proportion divided by the *given* factors of its first extreme gives a number which being divided by the last extreme equals x. Thus, $34051259090552516000 \div 35655260 = 955075233320$; and the quotient of this number divided by 209937 is 4,549,342,000.

If the plane of the great orbit be not inclined to the plane of the ecliptic, as M. Mädler supposed, then the mass of Alcyone must be deemed vastly greater than is here signified.

Question 7. *If the Sun and all the proper stars have no orbital motion, by what law are they "fixed" so as to prevent their gravitating toward each other?*

Answer. That of equipollent collateral pressure, or equal pressure of the ether on all sides of each solar orb. This answer is based on propositions 3 and 4, which affirm the finitude of the ether's bulk and stress, as well as the rotation of its volume. If the vehicle of Matter did not rotate, its centre would be the only culminating point of its concentric pressure, the only place wherein its contents would be subject to equal pressure from all directions. By rotating, its aboriginal pressure is reduced to one-half at its center and equalized from center to periphery, making its maximum pressure ubiquitous, so that a single body placed anywhere within the pericosm would be stationary. So are numerous bodies — all the solar stars — only on condition of being placed so far apart as to insure their permanent compression by the ether on all sides alike. In this predicament every particle is at rest, relatively, though absolutely all are in perpetual motion. In consequence of the Ether's concentric pressure together with its integral rotation, its volume is divided into numerous centers of gravity, or spheres of concentric gravitation, containing severally all the Matter of the universe. The spheres of space so demarkated are the proper spheres of gravity, beyond the precincts of which gravity is *nil.* The dimensions of these are not all homologous, as is indicated by the fact that all the proper stars at maturity are not of equal magnitude, but are largest in the galactic circle and smallest near the poles and axis of the pericosm.

If Newton's law of gravitation were literally true — that it is universely proportional to the square of the distance between collocated bodies — no particle could be insulated. But that law is practically demonstrable only within the solar system. Had Newton discovered the physical *cause* of gravity as clearly as he verily did discern the reality of its unknown "agent," he would not have failed to see that, the universe itself being finite, none of its attributes can be infinite; he would have apprehended the truth, that gravity, though a universal principle, is yet operative within local bounds, in a manner hypothecating numerous domains of stellar insulation.

The principle underlying this conception suffices to settle the question, entertained by certain living scientists, whether or not Sol will ever fall into Sirius. They are not correlated. It may be that in

time every member of the solar system will be pushed into the Sun, and that the round of its planetary evolution will be repeated, as possibly it has been and is destined to be for ever; but, according to the extant course of Nature and constitution of the physical world, no star of the galaxy will ever quit its station as the dispenser of light and heat to a community of life-bearing worlds peopled with similitudes of terrestrial humanity.

Question 8. ***How are the sidereal phenomena which astronomers have presumed to signify the orbital motion of the Sun and other solar orbs to be accounted for?***

Answer: The astronomic phenomena here adverted to have never been accounted for by any hypothesis to the satisfaction of any rational inquirer. Mädler's theory to this purpose was conceived, and has been accepted, only in the light of speculation. Several scientists have probed it only to be convinced of its falsity. Sir John Herschel made it one of the topics of his *Outlines of Astronomy*, from which I extract the following paragraphs.

"The whole of the reasoning upon which the determination of the solar motion in space rests, is based upon the entire exclusion of any *law* either derived from observation or assumed in theory, affecting the amount and direction of the real motions both of the Sun and the stars. It supposes an absolute non-recognition, in those motions, of any general directive *cause*, such as, for example, a common circulation of all about a common center. Any such limitation introduced into the conditions of the problem of the solar motion would alter *in toto* both its nature and the form of its solution. Suppose for instance, that, conformably to the speculations of astronomers, the whole system of the Milky Way, including our Sun, and the Stars, our more immediate neighbors, which constitute our sidereal firmament, should have a general movement of rotation in the plane of the galactic circle (any other would be exceedingly improbable, indeed hardly reconcilable with dynamical principles), being held together in opposition to the centrifugal force thus generated by the mutual gravitation of its constituent stars. Except we at the same time admitted that the scale on which this movement proceeds is so enormous that all the stars whose proper motions we include in our calculations go together in a body, so far as that movement is concerned (as forming too small an integrant portion of the whole to differ sensibly in their relation to its central point); we stand precluded from drawing any conclusion whatever, not only respecting the absolute motion of the Sun, but respecting even its relative movement among the stars, until we have established some law, or at all events framed some hypothesis having the provisional force of a law, connecting the whole, or a part of the motion of each individual with its situation in space.

"Speculations of this kind have not been wanting in astronomy, and recently an attempt has been made by M. Mädler to assign the local center in space, round which the Sun and stars revolve, which he places in the group of the Pleiades, a situation in itself utterly improbable, lying as it does no less than 26° out of the plane of the galactic circle, out of which plane it is almost inconceivable that any *general* circulation can take place."

Now, inasmuch as this criticism by the foremost astronomer of the nineteenth century is validly obnoxious to the Mädler theory, it is subsidiary to the Pericosmic Theory. Not that the younger Herschel had the latter theory in mind, nor that his argument pointed to any more definite conception of what should replace the former than that of the unknown "*law*" of mundane mechanics. His objection to the theory of solar and stellar orbits is threefold: 1. That it proposes their motion round different centers, without assigning a reason for their partial and sporadic affiliation; 2. That it proposes no "directive cause" of their motion in space; 3. That the Sun's suppositive orbit is widely angular to the plane of the galactic circle, "out of which no general circulation can take place." So, according to the cosmologic intelligence of Sir John Herschel, these three fundamental requisites to a legitimate theory, which are conspicuously wanting in M. Mädler's theory, are supplied by the Pericosmic Theory as essential elements thereof, making his reasons for rejecting that equally cogent for accepting this. What "*law* affecting the amount and direction" of solar and stellar movements in space can be more general than is implied by the integrant vehicular motion of Matter? How could the consentaneous motion of the Sun and stars in space be effected more adequately than by the rotation of their common vehicle? And why should the plane of their concomitant motion concide with the plane of the galactic circle, but for the fact of ocular evidence that the whole stellar system simulates the conceptive rotating pericosm, the rim of whose equator is merely misconceived and misnamed "the galactic circle?" It is obvious that Sir John Herschel had these questions in mind, or at least a clew to them, when he asked his readers to "suppose" they have a hinge upon reality; while *he* inadvertently forestalled their legitimate answers by taking for granted that, in case the galactic circle should chance to rotate, it might fly off in a tangent, unless "held together by the mutual gravitation of its constituent stars." Perhaps this fallacy, born of what he elsewhere calls "the mystery of mysteries," is all that prevented him from originating the Pericosmic Theory. But as the most eminent astronomer of his day, and with all his extraordinary researches regarding the theme of this section, it does not appear that he concocted any theoretic explication of those sidereal phenomena whence Mädler deduced his theory, but merely discovered and exposed the ineptitude of such tentative solutions of the problem as some of his predecessors had propounded. How to account for certain motions of apparent stars, or what the optic phrases thereof may signify, is still an open question with living astronomers. Proctor,* who has studied it as thoroughly as any of his professional class, regards its answer as altogether prospective. I have room only for a fragment of what he has said about it, in one of his *Familiar Essays on Scientific Subjects.* His lecture on Star-grouping, Star-drift, and Star-mist, delivered at the Royal Institution, May 6, 1870, opens thus:

"Nearly a century has passed since the greatest

*** This notable scientist died at New York, Sept. 12, 1888, a victim of yellow fever, two days before he was to sail for England, to fulfil a lecture engagement.**

astronomer the world has ever known conceived the daring thought that he would gauge the celestial depths. And because in his day, as indeed in our own, very little was certainly known respecting the distribution of the stars, he was forced to found his researches upon a guess. He supposed that the stars, not only those visible to the naked eye, but all that are seen in the most powerful telescopes, are suns, distributed with a certain general uniformity throughout space. It is my purpose to attempt to prove that this guess was a mistaken one; that but a small proportion of the stars can be regarded as real suns; and that in place of the uniformity of distribution conceived by Sir Wm. Herschel, the chief characteristic of the sidereal system is *infinite variety.*"

After stating the froward results of the elder Herschel's mistaken guess, and its insufficient modification by the younger Herschel, the self-poised disciple of both his illustrious predecessors takes up the subject of his discourse as follows:

"As to the existence of star-streams and clustering aggregations, we have evidence of a decisive character. There is a well-marked stream of stars running from near Capella toward Monoceros. Beyond this lies a long dark rift altogether bare of lucid orbs, beyond which again lies an extensive range of stars, covering Gemini, Cancer, and the southern parts of Leo. This vast system of stars resembles a gigantic sidereal billow flowing toward the Milky Way as toward some mighty shore-line. Nor is this description altogether fanciful, since one of the most marked instances of star-drift presently to be adduced refers to this very region. These associated stars *are* urging their way toward the galaxy, and that at a rate which, though seemingly slow when viewed from beyond so enormous a gap as separates us from this system, must in reality be estimated by millions of miles in every year." . . . . "A system of stars might really be drifting athwart the heavens, and yet the drift might be rendered unrecognizable through the intermixture of more distant or nearer systems having motions of another sort, and seen accidentally in the same general direction. This was found to be the case, indeed, in several instances. Thus the stars in the constellation Ursa Major, and neighboring stars in Draco exhibit two well-marked directions of drift. The stars beta, gamma, delta, epsilon, and zeta, of the Great Bear, besides two companions of the last-named star, are travelling in one direction, with equal velocity, and clearly form one system. The remaining stars in the neighborhood are travelling in a direction almost exactly the reverse. But even this relation thus recognized in a region of diverse motions, is full of interest. Baron Mädler, the well-known German astronomer, recognizing the community of motion between zeta Ursæ and its companions, calculated the cyclic revolution of the system to be certainly not less than 7000 years. But when the complete system of stars showing this motion is considered, we get a cyclic period so enormous, that not only the life of man, but the life of the human race, the existence of our Earth, nay, even the existence of the solar system, must be regarded as a mere day in comparison with that tremendous cycle.

"Then there are other instances of star-drift, where, though two directions of motion are not intermixed, the drifting nature of the motion is not at once recognized, because of the various distances at which the associated stars lie from the eye. A case of this kind is to be met with in the stars forming the constellation Taurus. It was here that Mädler recognized a community of motion among the stars, but he did not interpret it as I do. He had formed the idea that the whole of the sidereal system must be in motion around some central point; and for reasons which need not here be considered, he was led to believe that in whatever direction the center of motion may lie, the stars seen in that general direction would exhibit a community of motion. Then, that he might not have to examine the proper motions all over the heavens, he inquired in what direction (in all probability) the center of motion may be supposed to lie. Coming to the conclusion that it must lie toward Taurus, he examined the proper motions in that constellation, and found a community of motion which led him to regard Alcyone, the chief star of the Pleiades, as the center around which the sidereal system is moving. Had he examined further, he would have found more marked instances of community of motion in other parts of the heavens, a circumstance which would have at once compelled him to abandon his hypothesis of a central sun in the Pleiades, or at least to lay no stress on the evidence derivable from the community of motion in Taurus.

"Perhaps the most remarkable instance of star-drift is that observed in the constellations Gemini and Cancer. Here the stars seem to set bodily toward the neighboring part of the Milky Way. The general drift in that direction is too marked, and affects too many stars, to be regarded as by any possibility referable to accidental coincidence.

"It is worthy of note that if the community of star-drift should be recognized (or I prefer to say, *when* it shall be recognized), astronomers will have the means of determining the relative distances of the stars of a drifting system. For differences in the apparent direction and amount of motion can be due but to differences of distance and position, and the determination of these differences becomes merely a question of perspective. Before long it is likely that the theory of star-drift will be subjected to a crucial test, since spectroscopic analysis affords the means of determining the stellar motions of recess or approach."

Here, dismissing the subject of star-drift, the lecturer turns to the matter of star-mist, under this head including all orders of nebulæ, stating diverse parts of telescopic research, of which two are citable as being most relevant to the object of the present discussion, namely:

"First, as to the distribution of nebulæ: They are not spread with any approach to uniformity over the heavens, but are gathered into streams and clusters. The one great law which characterizes their distribution is an avoidance of the Milky Way and its neighborhood.

"Secondly, there are in the southern heavens two well-marked streams of nebulæ. Each of these streams is associated with an equally well-marked stream of stars. Each intermixed stream directs its course toward a Magellanic Cloud, one toward the Nubecula Minor, the other toward the Nubecula Major. To these great clusters they flow, like rivers toward some mighty lake. And within these clusters, which are doubtless roughly spherical in form, there are found intermixed in wonderful profusion, stars, star-clusters, and all the orders of nebulæ."

And now Mr. Proctor brings his very interesting lecture to a close, without having broached any theory, or suggested any principle according to which a theory may be constructed, to account for the astronomic phenomena which he so felicitously describes. Here is his peroration:

> "It remains that I should exhibit the general results to which I have been led. It has seemed to many that my views tend largely to diminish our estimate of the extent of the sidereal system. The exact reverse is the case. According to accepted views there lie within the range of our most powerful telescopes millions of millions of suns. According to mine the primary suns within the range of our telescopes must be counted by tens of thousands, or by hundreds of thousands at the outside. What does this diminution of numbers imply but that the space separating sun from sun is enormously greater than accepted theories would permit? And the increase implies an enormous increase in the estimate we are to form of the vital energies of individual suns. For the vitality of a sun, if one may be permitted the expression, is measured not merely by the amount of matter over which it exercises control, but by the extent of space within which that matter is distributed. Take an orb a thousand times larger than our Sun, and spread over its surface an amount of matter exceeding a thousand fold the combined mass of all the planets of the solar system: So far as living force is concerned, the result is — *nil.* But distribute that matter throughout a vast space all round the orb: that orb becomes at once fit to be the center of a host of dependant worlds. Again, according to accepted thories, when the astronomer has succeeded in resolving the milky light of a portion of the galaxy into stars, he has in that direction, at any rate, reached the limits of the sidereal system. According to my views, what he has really done has been but to analyze a definite aggregation of stars, a mere corner of that great system. Yet once more, accord-

ing to accepted views, thousands and thousands of galaxies, external to the sidereal system, can be seen with powerful telescopes. If I am right, the external star-systems lie far beyond the reach of the most powerful telescope man has yet been able to construct, insomuch that perchance the nearest of the outlying galaxies may lie a million times beyond the range even of the mighty mirror of the great Rosse telescope.

"But this is little. Wonderful as is the extent of the sidereal system thus viewed, even more wonderful is its infinite variety. We know how largely modern discoveries have increased our estimate of the complexity of the planetary system. Where the ancients recognized but a few planets, we now see, besides the planets, the families of satellites; we see the ring of Saturn, in which minute satellites must be as the sands on the seashore for multitude; the wonderful zone of asteroids; myriads on myriads of comets; millions on millions of meteor systems, gathering more and more richly around the sun, until in his neighborhood they form the crown of glory which bursts into view when he is totally eclipsed. But wonderful as is the variety seen within the planetary system, the variety within the sidereal system is infinitely more amazing. Beside the single suns, there are groups and systems and streams of primary suns; there are whole galaxies of minor orbs; there are clustering stellar aggregations, showing every variety of richness, of figure, and of distribution; there are all the various forms of nebulæ, resolvable and irresolvable, circular, elliptical, and spiral; and lastly there are irregular masses of luminous gas, clinging in fantastic convolutions around stars and star-systems. Nor is it unsafe to assert that other forms and variety of structure will yet be discovered, or that hundreds more exist which we may never hope to recognize.

"But lastly, even more wonderful than the infinite variety of the sidereal system is its amazing vitality. Instead of millions of inert masses, we see the whole heavens instinct with energy—astir with busy life. The great masses of luminous vapor, though occupying countless millions of cubic miles of space, are moved by unknown forces like clouds before the summer breeze; star-mist is condensing into clusters; star-clusters are forming into suns; streams and clusters of minor orbs are swayed by unknown attractive energies; and primary suns singly or in systems are pursuing their stately path through space, rejoicing as giants to run their course, extending on all sides the mighty arm of their attraction, gathering from ever-new regions of space supplies of motive energy, to be transformed into the various forms of force — light, and heat, and electricity — and distributed in lavish abundance to the worlds which circle round them.

"Truly, may I say, in conclusion, that whether we regard its vast extent, its infinite variety, or the amazing vitality which pervades its every portion, the sidereal system is, of all the subjects man can study, the most imposing and the most stupendous. It is a book full of mighty problems — of problems which are as yet almost untouched by man, of problems which it might seem hopeless for him to attempt to solve. But those problems are given to him for solution, and he *will* solve them, whenever he dares attempt to decipher aright the records of that wondrous volume."

This peroration is more to be admired for its rhetoric than appreciated for the precision of its scientific statements, some of which are open to criticism. How "an orb a thousand times vaster than our Sun," placed at a thousand times the distance of our Sun from its nearest neighbor, and surrounded by just a thousand times more planetary machinery than our solar system contains, is going to become a more economical dispenser of light and heat to its host of dependent worlds, than a thousand suns as large as our Sun, each surrounded by an equivalent of our solar system would represent in aggregate, does not appear in his argument to that purpose. It surely does not follow from his premise that the vitality of a sun is measured by the extent of space within which matter over which it exercises control is distributed. His illustration implies the reverse of what he apparently intended, namely: that "the space separating sun from sun is enormously greater than accepted theories would permit." For there cannot be an available distribution of matter "throughout a vast space all round an orb" without a corresponding vastness of magnitude in the central orb itself, the result of which *per se*, Mr. Proctor says, "is — *nil*." This "blind spot" in the field of his vision is opposed to the Pericosmic Theory, but with no damaging tendency. The same may be said of his näive assurance of "unknown attractive energies" and "the mighty arm of attraction." It is amusing (or would be but for the staleness of the usage) to observe how glibly even eminent scientists will talk of "attraction" in the very breath of deference to Newton as the famed discoverer of gravitation's *law*, with no recollection of his sagely contempt for "that notion," or else with clownish disregard of his protest against the imputation of having fathered it.

With a few inconsiderable exceptions, the average fragility of which is fairly exemplified by the two "mistaken guesses" just adverted to, Mr. Proctor's views so far as set forth in the previous citation, are quite in harmony with the Pericosmic Theory; at least, are in no wise antagonistic to, or inconsistent with, the fundamental principles thereof. This is what I shall now attempt to maintain in answer to question 8, with the conventional understanding that Mr. Proctor is a representative scientist; so that, if my position is tenable, it follows that the Pericosmic Theory does not conflict with any item of physical science, so far as evolved in the nineteenth century. This, not as the proper test of the theory, but, as prefatory to that, by purporting no valid objection to it. For though the scope of the Pericosmic Theory is verily world-wide, it is not logically amenable to so rigid an ordeal as the solution of all minor problems which are categorically comprised by its superlative compass. If it fail to yield a scientific answer to question 8, it nevertheless takes precedence of all other attempts to answer it, since, as appears above, no other theory has as yet been propounded for the nonce, which, in the judgment of pre-eminent scientists, is not oppugned by diverse astronomic facts and physical principles.

The testimony of practical astronomers concerning sidereal phenomena is acceptable only as descriptive of the visual aspects thereof — only as respecting phrases of reality the proper characterization of which depends upon other modes of intelligence. If, instead of such appearances, the observer relates inductions therefrom, or unwittingly mistakes what is subjectively apparent for things objectively real, the conceptive views of the reader of such supplements to observation and the data of their suggestion may be quite as authentic as those of the quasi-observer and supererogant reporter. When Mr. Proctor tells us that "Most intimate signs of association between lucid stars and the galaxy can be recognized — (i.) in the part extending from Cygnus to Aquila; (ii.) in the part from Perseus to Monoceros; (iii.) over the ship Argo; and (iv.) near Crux and the feet of Centaurus," — we are rationally bound to credit his testimony. But when he indorses the assertion of Huggins, as he does elsewhere, that "Sirius is receding from the Sun at the rate of about 29 1-2 miles per second, or some 930 millions of miles per annum," he opens a question which many a scientist who may never have looked through a telescope is competent to discuss.

Mr. Proctor's views of the sidereal system, or rather his report of its telescopic aspects, as set forth in the lecture from which I have quoted at large, may be summarized as below:

1. "The nebular and stellar systems form in reality but one complex system."

2. The galaxy is made up mostly of lucid stars,

with only here and there a nebula, or cluster of apparent stars.

3. "Nebulæ are not spread with any approach to uniformity over the heavens, but are gathered into streams and clusters. The great law which characterizes their distribution is an avoidance of the Milky Way."

4. The general trend of star-drift (comprising clusters and star-mist) is from the galactic poles toward the galactic circle.

5. All the visible stars *et cætera* belong to one grand system. If there be any out-lying galaxies they are too far away from man's abode for his recognition by any known methods of research.

This statement comprises all the sidereal phenomena to which question eight applies. How are they to be accounted for? I dare say, by no other hypothesis than that of the world's rotation. But, according to the Pericosmic Theory, these sidereal phenomena are not exceedingly marvelous — are, in fact, very like what, with due attention to their analogues in Nature and in Art, we should have predicted in advance of their telescopic appearance.

Think of the pericosm in its primeval predicament, the formation of which must be the theme of the first chapter in the history of cosmic evolution, to make that history scientifically complete. I shall not attempt to write that chapter now and here; but I claim that it is not less seemly to say, *Given the pericosm*, than, "Given a nebula." We are compelled to postulate a beginning for either, what experience testifies of every substantial entity within the scope of human intelligence. And the physical sphere of Nature — the vehicle of matter, — inasmuch as it were useless without its material contents, cannot be rationally regarded as much older than the stuff of which these are made. Besides, it is finite, and therefore not of necessity — therefore a thing made, and made in time: for all the works of Nature, so far as we know them, are wrought in time. Judging from what we know of the genesis of planets and suns, it seems unlikely that the pericosm, the whole world's vehicle, was made in a trice. When completely made, it had to be impleted with diffuse matter: this was another stupendous work to be effected in time, during which the pericosm was not rotating, and therefore was spherical in form. The creation of Matter in monatomic diffusion is the theme of the second chapter in the history of cosmic evolution. Then the third chapter opens with the impetus of creative power which caused the pericosm to rotate. It is just here that Science — *the science of the next century* — begins "to decipher aright the records of that wondrous volume," the extant Book of Nature.

Before the pericosm was made to rotate, its material contents were subject to a single, but continuous, impellent force, that of the Ether's concentric pressure, which was equipollent from circumference to center, where, if no other force had been super-added to that of gravity, every atom of Matter must have co-alesced in time to preternatural solidity. But when by some unknown agency the volume of Ether was instigated to rotate, every atom therein was impressed with a centrifugal tendency, not in direct opposition to the trend of the Ether's compressure, but in a direction parallel to the plane of the pericosmic equator, the stress of its centrifugal bent being proportional to the perpendicular distance of each atom from the axis of its vehicular motion. So the Ether's concentric pressure, being obliquely contravened, was not neutralized even in the plane of rotation, though in that part of the pericosm it was greatly disparaged, especially near the equator, whereas at the poles and along the pericosmic axis it held its own as before its nominal and partial antagonist obtained. Accordingly, the resultant stress of the two converging forces was differentiated incrementally from axis to equator, the gravity of matter vicinal to the latter being semi-neutralized, while that of atoms around the axis of their vehicular motion was not at all disparaged. In other words, the inchoate rotation of the pericosm generated a partial antagonist to the Ether's aboriginal pressure exclusively in and parallel to the plane thereof, leaving the polar and axial regions and their contents comparatively intact *in statu quo.*

The immediate mechanical effect of this dynamic predicament of the pericosm was two-fold: its sudden expansion in the plane of its rotation, and the simultaneous depression of its poles and polar regions, thus shortening its axis and transforming its primeval contour from that of a perfect sphere to that of a discordal spheroid, as now indicated by the extant arrangement of the stars.

Though the interim between the beginning and end of this transformation was probably brief, its motoric issues were anything but transient. It is rationally conceived that its momentum must be everlasting, though virtually nullified by the ultimate equilibrity of its dissident factors. In the first place, it initiated the institution of a cosmic labyrinth of motivity as the dynamic and formative agency of physical evolution, whereby the two pericosmic forces were brought into collision. Then the resultant of this collision was diversified in a way to generate a series of spiral and vortical motions the diverse conflicts and combinations of which culminated in the elaboration of innumerable nebulæ. Though unable to trace out each minutia of the operation, co-operation, conflict and combination of those diversified forces, so as to perceive precisely *how* the said result was achieved, we do perceive somewhat of the mechanism thereof, and are familiar with some of its products. The motive parents of nebulæ did not die of childbirth. Each new-born nebula conserved the momentum of every force which had been applied to its substance in the process of its conformation. When the two poles of the pericosm were depressed by its inchoate rotation, the diffuse matter native to those opposite regions became the bases of two simultaneous spiral drifts of vehicular motion, which, circumvolving the axis, met in mutual repulsion at the center of the primal sphere of Ether, whence, in virtue of the disparaged gravity of Matter native to the outer region on either side of the plane of rotation, there resulted a binary expansion of both Matter and Ether in all directions perpendicular to the axis of rotation; and this binary expansion was bisected and dually subdivided into innumerable centers of vortical motion whose common marriage with gravity gave birth to the family of nebulæ.

As to the succeeding stage of nebular evolution whereby nebulæ were permanently posted and isolated from each other in respect of gravity, to be in time resolved into independent solar systems, it were needless to repeat, or enlarge upon, the answer already given to question 7. My answer to question 8 is found by analysis of the foregoing conceptive views to consist with the following general propositions.

1. Since the prime impetus to the motion of Matter in a way to conplement the use of gravity was the transformation of its vehicle from a perfect sphere to a discoidal spheroid, the general drift of its surviving momentum could be protracted only in the direction from the poles and polar regions of the rotating pericosm toward its expanded equator.

2. Nebulæ must have been evolved and subsequently transformed to solar systems first of all in the regions about the pericosmic equator, and therefore lucid stars ought to be more numerous there than elsewhere — just where Mr. Proctor testifies that they are observed to be most abundant.

3. The centrifugal force of the pericosm's rotation

balances the Ether's pressure at the pericosmic equator, and this is why there is no drift of stars therein, or in the galactic circle.

4. The primordial conflict of the two cardinal forces of Nature — the concentric and the excentric — resulted in a differential motion of Matter in its primitive diffusion throughout its vehicle, so that the confirmation of original nebulæ is not as yet consummated; and this is why the sidereal system is still fraught with all forms and stages of nebular, stellar, and planetary developements, including "star-mist" or nebulons matter apparently beyond the realm of pericosmic motivity.

5. Whether or not there be other sidereal systems than that of human intelligence, is a query of imagination. It can never be a problem in the scientific sense of the word. All the material contents of the pericosm are colligated by the Ether's pressure; and this aggregate of material things is the exclusive "Cosmos" of material existence. The agent of gravity is identical with the medium of light; therefore, whatever is within the pericosm *is*, or may become, visible; but nothing beyond its precincts. It is possible that a telescope may yet be invented by means of which we may see *to* the walls of the physical universe, but never *them* nor anything outside them.

My conceptive answer to question 8 as outlined above is warranted by the alleged play of mechanical principles in that device of art known as the Plateau experiment which, as shown in chapter XII. typifies the process of cosmic evolution. That experiment Herpert Spencer regards as countenancing his reasoning as to the genesis of the solar system; and the reporter of its aspects as tried at *the Smithsonian* cabinet in Washington, D. C., says "No thoughtful man can witness its trial without feeling that his mind may be standing at the very threshold of creation." The Plateau experiment purports what ought to complement "the Nebular Hypothesis." But for its rationale we must postulate the world's rotation. It is only the Pericosmic Theory that insinuates its antitype.

Recurring now to the larger subject of this chapter, the intelligent reader will perceive that I have posited deductively within the scope of that theory all but one of the twelve propositions announced as correlative constituents of its validity. It remains to deal with the fifth proposition as I have dealt with its eleven correlates; which I apprehend no better way of doing than to attempt an answer to —

Question 9. *Why is a molecule of water* (H_2O) *apparently smaller than either of its components? and why is an atom of hydrogen large as an atom of oxygen, though this is sixteen times as heavy as that?** The answer depends upon proposition 5 and its correlate proposition 6, both of which are based upon the collective truth of the other 10 propositions.

Answer: A motionless body of concentric force must of course be spherical. Give it rotary motion and it becomes speroidal. Increase its velocity of rotation and it becomes discoidal. If made to rotate with sufficient velocity it will expand to central vacuity, forming a revolving ring. That is the shape of an atom of oxygen, as well as of hydrogen, which are distinguishable in point of contour dependent upon velocity, and in point of weight dependent upon quantity of body. The ring of oxygen is but little larger externally than the ring of hydrogen internally; but while the oxygen atom displaces sixteen times as much ether as the atom of hydrogen, the latter rotates with sixteen times the velocity with which the oxygen atom rotates. This enormous velocity of rotation makes the hydrogen atoms exceedingly repulsive to each other, so that in collection they occupy as much space as the heavier atoms of oxygen. Now, imagine an atom of oxygen to be plunged in the midst of a collection of hydrogen atoms. An oxygen ring, being smaller at either margin than at its equator, is repellent (though less so than a hydrogen ring) at all points except at right angles to the plane of its rotation. By their equatorial repellency rotating atoms are collocatively adjusted for combination. In this attitude of juxtaposition the intervening ether is diminished, the external pressure thereof is relatively magnified, and thereby a hydrogen atom is pushed to contact with either side of an oxygen atom, the annular margin of which is enclosed by the annular hydrogen atom, and a sudden diminution of ether between them enforces their coherence. This marriage of atoms, though in vulgar phraseology "without issue," is of signal consequence. The superior rotary motion of the hydrogen atom is suddenly checked and compromised with that of the oxygen atom. The three conjoined atoms now rotate as one body three times as fast as an isolated oxygen atom or three-sixteenths as fast as an isolated hydrogen atom. Such being the chemical constitution of a water molecule, the two fractions of the disparate rotation of its components are reciprocally aliquant measures of the motoric product thereof. Therefore it is likely that the shock of their unification begets a perpetual commotion in the substance of the new-made molecule resulting in a constant, rapid and forcible ripple in its annular margins; and this may be a device of Nature for preventing the mutual coherence of water molecules at their polar surfaces, without which provision evaporation would never occur; vapor being nothing else but the dispersion of water molecules (not their dissolution) in effect of collision *alias* heat, which, when intense, isolates them to invisibility. For, though heat alone is conceptively adequate to this effect, the incentive to that oscillation of atoms in which heat consists is casual, being due to their collision and rebound, not alone in the line of gravity, but more generally in all directions including the opposite of gravity; and this well-known behavior of atoms in all departments of thermal physics is reasonably accounted for by assuming that the molecules of water betray the structure of matter and the principles of chemical action in general, this involving a phase of energy which rivals that of the ether.

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* "It will be noticed in the case of water that the doubling of oxygen is the consequence of halving the hydrogen; if we take *equal volumes*, their weights are as 16 to 1; but as there are two volumes of hydrogen, the composition of water becomes H_2O, the oxygen being 16."—*Youmans's Chemistry*, page 71.

Moreover, water molecules simulate the form and supplement the agency of oxygen atoms in most of the chemic changes to which matter is subject, as might be inferred, if not otherwise manifest, from the presence of water in the composition of every species of vegetal and animal life. About three-fourths of the substance of all flesh is water. But that is not well-water nor rain-water. These have no nutritive value, whereas whey is food for pigs, and turnips will fatten kine. So the chemic value of an oxygen atom may be lessened or enhanced by the company it keeps, one abstracted from a molecule of the oxide of iron being inferior to one just let loose from a molecule of water. In short, the main dynamic principle of chemical action is dual; its co-operative agents are the ether's pressure and the differential rotation of atoms, the latter being for the most part instigated by diverse combinations with either component of water molecules, whose inherent rotation is relatively supreme. According to this conceptive view of the subject, there is but one generic formula for the genesis of molecules of every descriptive species, and that is the cöalition of a *nucleus* and a *nidus*, of which the former may be either simple or compound, and the latter, simple, compound, or complex. The *nidus* is of course always external to the *nucleus*. As correlated in a molecule of water, an atom of oxygen is the *nucleus* and two atoms of hydrogen the *nidus*. But, as said above, a molecule of water itself often becomes the *nidus* of a radicle, either simple or compound. This is exemplified in the hydrate of lime (CaO,H_2O), wherein a molecule of water absorbs—becomes the *nidus* of—a molecule of the oxide of calcium (CaO). The relation of H_2O to CaO in the one case is perfectly analogous to that of O to Ca in the other.

It is a fact of general observation that iron will rust in contact with air or water, but that its oxidation proceeds much more rapidly when the atmosphere is impregnated with moisture. Chemically analyzed, its process yields in apparent consecution the prot-oxide of iron (FeO), ferric acid (FeO_3), peroxide of iron (Fe_2O_3), and magnetic oxide of iron (Fe_3O_4).* It is conceivable that the successive changes take place in the following order. In the first place, a spherical atom of iron is absorbed by a ring-form atom of oxygen, and the composition becomes a molecule of the protoxide of iron (FeO). This may occur in a perfectly dry atmosphere. Then let a molecule of this protoxide be absorbed by a molecule of water, and two changes will ensue, to wit: (*a*) an oblate expansion of FeO by accession of O, and (*b*) a coincident contraction of the water molecule's chief component—the oxygen ring—(by accession of Fe) whence the two minor components thereof, as the only alternative to their preternatural constriction, rebound incontinently, and thus H_2 are set free, leaving FeO_2 to be immediately reinforced by another atom of oxygen from the atmosphere, making a molecule of ferric acid (FeO_3). This is said to be exceedingly unstable, and therefore in contact with the source of its original base, by affiliating a single atom of iron, it becomes a molecule of peroxide of iron (Fe_2O_3). Finally, let a molecule of this substance absorb one of the protoxide of iron (FeO), and the result is a molecule of the magnetic oxide of iron (Fe_3O_4). A molecule of this substance is conceivable as three spherical atoms of iron in linear contact (the *nucleus*) inclosed by four conjunct oxygen rings (the *nidus*), whose rotary motion is considerably diminished by this association.

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* "Iron has a strong affinity for oxygen, with which it forms four well-marked compounds, viz.: the protoxide FeO; the sesquioxide or peroxide Fe_2O_3; the magnetic oxide, supposed to be a combination of the two preceding, and having the formula FeO, $Fe_{.}O_4$, or Fe_3O_4; and ferric acid FeO_3."—*Youmans's Chemistry.*

The functional simulation of oxygen atoms by water molecules is indicated in diverse ways by their ready combination with oxides and acids. In a molecule of sulphuric acid (SO_3), for instance, O_3 becomes the *nidus* of S; but in a molecule of the protohydrate thereof (SO_3,H_2O), H_2O is the *nidus* of SO_3, which, in molecules of the bihydrate and terhydrate of this acid, is also the *nucleus* of $2H_2O$ and $3H_2O$ respectively. Though I cannot cite a direct statement of any eminent chemist to this effect, yet, upon reading in *Chambers's Encyclopedia* that "the compound formerly known as *anhydrous sulphuric acid* possesses none of the characteristic properties of an acid," but that "when thrown into water . . . . the solution has all the properties of ordinary sulphuric acid," the inference that the caustic action of the latter substance is due to a chemical combination with water molecules seems unavoidable. But stronger even than this inference is the rational alternative of supposing that all the difference between the *oil of vitriol* and "a colorless crystaline solid, which is tough and ductile, and can be molded in the fingers like wax without injuring the skin," results from the mere liquefaction of this solid. The specific attributes of the hydrates mentioned above wherewith the acid is indued by accession of water, are explicable only as issues of the chemical agency of water molecules.

It may be that chemical action viewed in the light of the Pericosmic Theory will entail certain emendations of its conventional phraseology, if not of its terminology. The *teroxide of sulphur* is certainly not less express than the term *sulphuric acid;* the epithet *ter-oxide* signifying three oxygen rings so conjoined as to form the *nidus* of an atom of sulphur as the *nucleus* of a molecule which, being smaller than a molecule of water, is readily inclosed by the latter as the *nucleus* of a molecule of the *oil of vitriol*, whose graphic chemical name is *the protohydrate of the teroxide of sulphur.* According to this nomenclature, sugar is correctly named *the hydrate of binoxidized carbon.* Let us see *why.*

The following duplex statement as to the probable features of chemical action when sugar is produced is copied from page 411 of *Prof. Youmans's Class-Book of Chemistry.*

"To produce an atom of sugar an atom of carbonic acid is taken, COO; half its oxygen is separated, making CO; an atom of water is then decomposed, and its hydrogen made to replace the separated oxygen atom, thus COH. Twelve atoms of carbonic acid, and twelve of water, changed in this manner, give C_{12} H_{12} O_{2}, or the glucose group without its combined water.

"It has been stated that this class of bodies, sugar, starch, cellulin, etc., are remarkable in having their oxygen and hydrogen in the exact proportion to form water, so that they may be regarded as hydrates of carbon. On this view we have but to suppose *all* the oxygen removed from the carbonic acid, and the resulting carbon joined directly to water, to explain the synthesis of these substances. It will be noticed that the deoxidizing process is carried much farther here than in the case of acids; to produce an atom of sugar, C_{12} H_{12} O_{12}, 24 atoms of oxygen are set free."

This extract represents two hypothetic theories, which differ as to *how* saccharine substances are produced, but agree as to the source *whence* they are derived. Of course, only one of the incongruous twain can be wholly true. To adopt either is to reject somewhat of its dissentient partner. The process described in the first division of the quotation involves the decomposition of two molecules (one of carbonic acid and one of water), whereas by the process proposed in the second division the same result follows the decomposition of CO_2 alone. This, then, is the probable method of Nature, whose ends are generally reached by the simplest means and shortest ways. Hence the scientific conclusion that molecules of sugar "may be regarded as *hydrates of carbon.*" It will presently appear that an accurate index to their composition is obtained by slightly modifying this relevant phrase.

To produce a molecule of sugar, a molecule of water must absorb the *nucleus* of a molecule of carbonic acid, the *nidus* thereof being set free. But *why* and *how* are the two atoms of oxygen set free? The answer to this question is not to be found within the limits of my book-lore. To find its answer we must begin our inquiry by recollecting what is said above, that the chemic aptitudes of an atom may be enhanced or disparaged by association with other atoms, and that the atomic *nucleus* of a molecule of carbonic acid has been indued with extraordinary rotative energy by the superior rotary motion of the two oxygen atoms constituting the *nidus* thereof, though no momentum thereof may remain after these are set free. An atom of carbon in its pristine state is comparatively inert and probably spherical; but when abstracted from carbonic acid and absorbed by a molecule of water, it is either spheroidal or discoidal, having been oxidized twice over, and not being *deoxidized*, but only *deoxidated*,* when transferred from a *nidus* of two oxygen rings to one consisting of an oxygen ring supplemented by two hydrogen rings. It is only more expanded by the transition, so as to contact with the inner surface of the *nucleus* of the water molecule, which it (in effect of the increased external pressure of the ether in accord with its diminution between the *nucleus* of the water molecule and the intromitted carbon atom) virtually contracts to cöalescence therewith. Prior to this event, however, the whole molecule of carbonic àcid must enter the cavity of the water molecule, and be so posited that its carbon atom occupies the space within the plane of the water molecule's atomic *nucleus* — its oxygen atom — with which, as already stated, it contacts. In that case, it is flanked by the two oxygen atoms which prior to this juncture constitute its cognate *nidus*. Accordingly, these two oxygen atoms are in the planes of the two hydrogen atoms which constitute the *nidus* of the water molecule; and we now approach conceptively the nick of their exit therefrom, which takes place for this reason: When the carbon atom is expanded as aforesaid, the two oxygen atoms are also expanded in like manner, but on either side of the carbon atom, and in the planes respectively of the two hydrogen rings, whose velocity of rotation is one-sixteenth greater than the normal limitation of inherently-rotating oxygen atoms. Therefore, the divorced consorts of the carbon atom are not *re*-married to the *nidus* of a water molecule, but roam at large. And what is the result of their desertion and the new marriage of their late partner? Not the union of carbonic acid and water, nor the cöalescence of a molecule of water with an atom of carbon merely; but the chemical combination of a water molecule with a *bin-oxidized* atom of carbon. Why not name it for just what it is, — *the hydrate of bin-oxidized carbon?* It is *that* only with reference to the formula of *the* chemical action of which it is the product; and *this*, when realized, is neither more nor less than if the process had not embraced an excluded element. It is impossible for one atom to supplement or impair the inherent attributes of another, except reciprocally by and during their chemical combination. This statement is justified by the universal experience of practical chemists, whose accounts imply that whenever a compound substance is decomposed each element of its composition reverts at once to the pristine measure of its rotative capacity. If it were not so, — if after being compromised by association the elements of compounds retained a momentum of the increase or diminution of their respective aptitudes so effected, they would in time be mutually assimilated so as to nullify their use as chemical agents. A water molecule will not absorb an isolated atom of carbon because its cavity is too broad to admit of the contact of its inner surface with the contour of the intromitted globule. But, upon the same principle of chemical action, an uncompromised oxygen atom, whose aperture is one-sixteenth smaller than that of a water molecule, *will* absorb a pristine atom of carbon, because this globule by introvention nearly fills the cavity of the oxygen ring, and the increased disparity of the Ether's internal and external pressure thus occasioned consummates their cohesion. These reflections verge to the conclusion that the compound rotative energy of *the hydrate of binoxidized carbon* is only equal to that of *the hydrate of carbon;* but that these are correlated as antecedent and consequent, this being traductive from that. Both designations are relevant to a discriminate conception of the modality and essence of saccharine matter apart from its taste, which of course is subjective and not amenable to chemical methods of investigation.

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* **Disparted from oxygen, yet retaining the virtue of combination therewith.**

The foregoing treatment of question 9, though less than a moyety of what might be condignly said in reply, is sufficiently subservient to the purpose for which the question was put, and its further answer may now, with like relevance to the larger subject of this chapter, give place to —

Question 10. *What does it signify, that the rotative energy of atoms is permanently incommutable; that, after being compromised by association, they invariably resume their pristine endowments of rotary motion, as soon as they become isolated again?*

The answer is not far-fetched: it comes intuitively, almost without being sought.

Answer: The fact that atomic *motivity* is never propagated, but only *motion*—the *effect* of motive agency,—signifies that inherent motion, which is proportional to corporeity or bulk of body as the gauge of inertia, is perpetually persistent; yet not *self*-persistent, assuredly; but *made* to persist by the same causal agent whereby atoms themselves *exist* (*made to be*) as globules of concentric force, namely, *creative power*, which is conceptively identified with the constant volition of *the Infinite Mind.* It signifies furthermore, that inert matter cannot be indued with abnormal motivity, or self-moving energy, so as to move otherwise or longer than it is *moved* by some extraneous motor. This is a flat contradiction, however, of the old nominal axiom "that a body once set in motion continues to move on forever, till somehow obstructed in a way to stop its motion." Yet it is only within the pericosm that this proposition *seems* to be verified. It is only in effect of the ether's pressure that motion is propagated from one body to another so as to be retained by the latter after separation from the former; and this is the only concept of momentum, which obtains, not upon the negative principle of matter's inability to stop moving when incidentally moved (for this is as predicable of a rotating atom as of a planet traversing its orbit), but because of the perpetual impetus of the ether's motific collapse behind it. Behind a rotating atom no such collapse takes place; nor is there any friction between it and its environing ether to obstruct its transposition. Thus all the material elements are free to combine and consolidate their special aptitudes, and it costs them nothing to resume or revert to their respective grades of rotative energy. But the ether's pressure is all that enables them to combine, or rather that *causes* their combination, which, however they might consort outside the pericosm, would be utterly abortive.

This chapter is inconplete, but no more so than its subject-matter, by virtue of the ultra-perceptive bounds of its modality. Vain would be the attempt to digest it all. My conclusion may as well be curt, since it must be abrupt. It is but to advert to the heading of my argument, which is literally world-embracing. *The Pericosmic Theory encompasses the field of scientific research.* This fact predetermines the ordeal of its verity. Its test must be as comprehensive as its scope. What is it then? It is threefold:

1. Its competence to account for all physical phenomena which are traductive from either of the two converse trends of cosmic motivity, the concentric and the excentric.
2. Its non-contravention by any known principle or phenomenon in mundane existence.
3. Its affiliation of all the natural sciences by the solidarity of its twelve constituent propositions as propounded in the beginning of this chapter, whereby it is identified with the germ of *Cosmology Proper.*

Is it possible to validate a hypothesis, or vindicate a theory to a more rational conviction than should follow this scientific test of *The Pericosmic Theory?*

The science of the Universe must inchoate with penetrating the mystery of gravity, by discovering the imbodiment of that dynamic principle by which Matter in all its disparate aggregations and predicaments is coërced, subordinated and made subservient to the diverse operations of Nature, all of which conspire to achieve the paramount process of Evolution. How can Matter be thus controlled except by a force embracing it; that is, by a force whose imbodiment both *differs from* Matter and *incloses* it? These conditions are just what the pericosmic Ether is known to represent, even as the medium of light. And when the dynamic attribute of the Ether is considered it becomes evident that the alleged issues of its relation to Matter must of necessity ensue therefrom. For want of this preliminary information, all attempts to describe the Cosmos as an individual entity have proved abortive hitherto. Now, this desideratum is supplied by the Pericosmic Theory.

So long as scientists dawdle with "the notion of attraction" in physics, they must ignore the rationale of gravity and gravitation. The physical agent of gravity can be no other than the vehicle of Matter. Therefore, to ignore the agent of gravity is moreover to ignore the vehicular motion of Matter, which, as an attribute of the Cosmos,is of no less significance than gravity and gravitation. For the two-fold reason here stated, the Pericosmic Theory must be the germ of Cosmology. Thus the claim made by the terminal clause of the title to this essay is authenticated, as to both its predicates: for, if the Pericosmic Theory is preliminary to Cosmology, it follows that its Sequel is also preliminary to Philosophy Proper, as will appear in succeeding chapters.

CHAPTER XIV.

CONNOTATIONS OF THE PERICOSMIC THEORY.

In this chapter it is proposed to designate with comment a class of conceptive truths which come to light by rational consideration of the physical world as represented in the body of this essay. It may be said without as ymptom of arrogance or egotism, that herein the reader is invited to look at the physical world as an individual thing, a complex whole, not as "a mighty maze," but as a mechanism, an intelligible structure evincing both a *plan* and a *purpose* which it is fitted to achieve, and that in a guise more definite and perceptible than astronomic science has heretofore made possible. Yet hardly a rational thinker may duly appreciate the work of those special scientists to whose diverse explorations of Nature's partial aspects we are indebted for a comprehensive view even of the stellar system; since, without the veritable facts of their discovery, there were no means of verifying our notions of the correlation of natural phenomena, and the consequent solidarity of Nature's conceivable attributes, however rationally we might have speculated thereabout. In view of the myriad sources of my own scant information incentive and preparative to my study of the magnificent theme to expound which has engrossed my thinking faculties thus far; impressed as I am with the sentiment of obligation to those numerous promoters of special science who have conspired to supply me with the premises for an important inference; I am not disposed to boast of the *impromptu* measure of the part I have acted in drawing that inference, or to pride myself upon a gist of originality which proves to be comparatively infinitesimal. In the way of such a motive to literary effort, I claim nothing which the public has power to withhold, nothing beyond the complacent consciousness of having done what I could to enlighten my own mind, regardless as possible of the casual effectiveness of my intellective endeavor to enlighten others; a desideratum, to be sure, but one which I can neither help nor hinder; inspired, nevertheless, with involuntary hope and belief that what is useful to me will prove to be of humanitary utility.

I have now done with the exposition of the propounded theory; but of its deductive import, its fitness and tendency to consociate the special sciences as the logical base of philosophy, I have a word more to say. This word is analytic as well as synthetic, and so resolvable into a class of truths, as I began to say above, by the discriminate announcement and discussion of which I purpose to answer the question, *What does the Pericosmic Theory signify*, over, above and beyond its cosmologic import?

This question is mediate to Science and Philosophy, and as such is of greater importance than any which can be asked in furtherance of science proper. For *science* itself, taken in its broadest scope, is available only to life in *this* world whereas *philosophy*, understood as to the rationale of what science imports, enhances the worth of life here *and* hereafter, by discovering its auspiciousness and perpetuity. My answer to it is dual, inasmuch as I conceive the Pericosmic Theory to connote two classes of truths, namely; those relevant to science proper, as tending to supplement cosmology; and those relevant to philosophy proper, as tending to reveal human destiny. The truths of either class so distinguished are numerous, and I shall not name them all. This chapter will include but four of the former class.

I. *The finitude of physical nature.*

This is obviously connoted by the descriptive form of the pericosm, as well as by its rotation. The attribute of concentric force, which is predicable differentially of all spherical bodies and superlatively of the universal receptacle of Matter, is consistent only with both a center and a circumference, whereas neither of these can pertain to unlimited extension. Though the idea of infinite space subjectively simulates the conception of an immense globe, it is deductively complemented by the notion of boundless dimensions, fathomable only by infinite intelligence. The rationale of gravity certifies the limited sway of its physical agent, which, as identified with the medium of light, though transcendently potent, is demonstrably finite. So to the attribute of excentric force, cognized in cosmic mechanics as the compeer of gravity, traductive as this is from the compressure of the Ether and as that is from the rotation of the Ether's volume, is duly ascertained to be finite as being co-efficient with gravity in generating planetary motion, all examples of which within the range of astronomic intelligence are definitely mensurable. Moreover, all physicists agree in assurance that matter consists of infinitesimal atoms, essentially immutable, whereof all the contents of the pericosm are composed; and though even the stars, each supporting a family of planets, are apparently innumerable, while comets and meteors swarm in the interstellar spaces in multifarious similitude of fishes in the ocean, yet the conception that the number of atoms of which each particle consists and the number of particles which in aggregate constitute the material frame of Nature are respectively definite and computable by adequate intelligence, is unavoidable and as valid as the axiom that an infinite number of finite things is unattainable. "Infinite is that which is so great that nothing can be added to it, or supposed to be added," wrote Dr. Day, discriminating the philosophic from the algebraic signification of the word. The sensible world is material, and matter is quantitative; "but no idea can be formed of a quantity so great that nothing can be supposed to be added to it. In this sense, an infinite number is inconceivable." The number of things of which the substantial part of Nature consists is marvelously great, but not infinite. "It is absurd to speak of the *greatest possible* number. No number can be imagined so great as not to admit of being made greater." To the world of Nature something is always being added, yet with no tendency to make it infinite. I know this is contradicted by certain scientists of the 19th century; that even Dr. Tyndall has seconded Helmholtz as saying *in italics* that "*nothing is created.*" But common-sense maintains anent that bald assertion that there is one more sagely yet fallible thinker in this world than there would have been if Helmholtz or Tyndall had never been born.

II. *The dependence of all natural phenomena on the correlation of two stringent species of physical force, static and motoric.*

These two primordial constituents of evolution, albeit accredited only as apparitions of entity and energy, are doubly represented by the Ether and Matter, wherein they co-exist disparately, yet co-ordinately in view of their co-incident functional vocation; for it is easy to perceive that their co-existence in the Ether alone or in Matter alone would fail to be effective; that to serve as implements of evolution *these* also must be brought together so as to interact, as they are and can be induced to do only by an antithet to their quiescence. This is the rebound of compressed concentric force in the guise of superinduced excentric force. So the virtual aptitudes of subordinate atoms as well as the particles resulting from their agglomeration, must be abortive so long as they chance to be consigned to isolation. And the principle of correlative use waxes and widens with the aggregation of atoms, that of their most available compounds being also most dependent on collocation in accord with reciprocal attributes; as planets must be barren without a sun and a lone sun can only waste its life-giving energy.

These two alleged co-agents of cosmic evolution are logically reducible to the dual trend of a single dynamic principle: for *what is force per se*, or what does it prove to be when all its manifestations are, so far as is practical, rationally construed? To say it is "that which produces or tends to produce, resists or tends to resist, motion," is insufficient, because too general if not too vague for the purport of a concept. As a verbal definition it subserves the immediate aim of science, and may be as apt as any that is likely to obtain conventional acceptation; but as to explication, it does not touch the question. It denotes a predicament in which we can only speculate for truth's sake; and why not heed a cue of introspection?

Force is *something*, most certainly; but the word *thing* is all-inclusive. Yet all conceivable things are classifiable according to these five categories, to wit: *Entities*, *Attributes*, *Acts*, *Modes*, and *Relations*. Does Force belong exclusively to any one of these categories? We shall see.

Entities are things of which attributes are predicable. Attributes are things essential to the being of each entity of which they are predicable. Acts are predicable only of sentient entities. Acts are always voluntary and germane to a purpose incited by aspiration for the prospective issue of endeavor whence independent action springs. Insentient entities are not conceivable as *acting*, but only as mediating by correlation of apposite qualities the issues of concerted action by sentient agents, notably those which appear in the sphere of Art; and the like must be true and should be cognized of their apparent agency throughout the realm of Nature's mechanic power. To this end, perhaps it would favor philosophic apprehension of occult agency in the process of existence to subdivide the category of attributes, allotting *faculties* to sentient beings exclusively and predicating only *aptitudes* and *susceptibilities* indiferently of sentient and insentient entities.

Now, in considering as to which of the five categories of things physical force belongs, we are reminded that two kinds are phenomenally suggested, and may they not be categorically distinct? The fancy that *therefore* they may be is rebutted by the subjoined reflection that man, brute, plant and pebble are all of the same category, though of different genera. Howbeit, the distinctive character of the two species of force is better discovered by studying their phenomenal manifestations separately.

Motific force, as identified with the cause of motion, must antecede motion itself, as well as *body* which is the base of motion. Therefore it must be unsubstantial. Then it must also be formless; yet, not being infinite, it is inconceivable as an entity in similitude of space, and is apprehensible only as the *sway* of an absolute power. It being thus discriminated from the category of entities, its immediate issue is scientifically identified with the transitional commotion of static force as vested in the constituents of Matter and in the indivisible expanse of Matter's ethereal vehicle. This conception over-reaches without nullifying the scientific apprehension of motific force as consisting with the momentum of the Ether's primordial and persistent grasp of Matter, complemented by that of the pericosm's inherent rotation, whereby Matter is perpetually indued with *vehicular motion*. This is but another aspect of motific force, or rather its issue, yet no less a *sine-qua-non* of cosmic evolution than gravity, with which it virtually co-works to the conformation and permanent collocation of suns and planets.

So reasoning, *motific* force, though simulating the spring of all motion, appears to be not an entity but an apparition of formless energy. But *static* force beseems an entity. Must not the pith of body be substantial? Nay, the *pith* of body is not *body*; it is the way that body is made. In reality, what appear as two species of force differ only as two *modes* of one and the same agency. Is it possible to distinguish either from an incessant *act* of creative power? To put this question is to anticipate—

III. The ultimate mystery of mundane existence.

This is cognized by all sagely thinkers, and is not to be evaded by any one who aspires to know what existence is, or what it is to exist. The question is not answered, and the mystery is never to be eluded, but only aggravated, by assuming the eternity of matter and motion. Whatever is eternal is immutable, even as is conceivable of Time and Space; but mundane existence is characterized by multifarious and perpetual mutations. To affirm its eternity is therefore absurd; and absurdity must succumb to mystery which conserves possibility and therefore is tolerable, whereas absurdity is to be respected only for its aptness to rebuke assumptions of what is impossible.

The first step toward the apprehension of what it is to exist, is to distinguish that which is of necessity from that which obtains only as a product of causation. All things within the sphere of rational conception are classifiable either as things that *must be* or as things which are *made to be.* This discrimination, which is intelligible enough when stated, is generally blinked and often quite ignored only for want of a symbol to complement the meaning of the word *existence* which, primarily importing an object of sense and still implying the contingency of relative being, is hardly susceptible of modification or enlargement of meaning when applied to absolute entities. The disideratum thus designated is attainable by merely appropriating the word in use to indicate whatever is *made to be,* instead of "the state of being," as *existence* is generally defined in dictionaries; and coining another word, say *sempersistence,* to denote *the being of things whose nonentity is conceivably impossible,* including all *necessary truths.* According to this amendment of the conventional diction, Time and Space do not *exist;* as things of necessity, they *sempersist*—stand-ever-the-same. Moreover, the concept of Nature should tally with that of existence *in toto,* the word *nature* signifying, according to Webster and other lexicographers, "whatever is made or produced; a word that comprehends all the works of God." So Time and Space, and all discrete realities, are preter-natural, or ultra-natural, that is outside Nature, not of it; not *un*-natural, nor conceivable as *super*-natural, this last epithet being advisedly appropriate to the *cause* of existence, cognized as *the Infinite Mind* and best apprehended as *the Absolute Person,* who is by no means *self-existent,* but uniquely *sempersistent.* This thought, however, is transcendental to science; that is to say, so far as science has obtained, or can obtain apart from the Pericosmic Theory. But supposing all that is announced above as mediately inferential from that theory, as well as what it directly implies, to be duly authenticated; does this eligible position avail to dispel the mystery of being, either existent or sempersistent? Not at all. Science will never peer beyond phenomena to *see* in what static force consists or to percieve the hand by which the pericosm is made to rotate. And vainly, too, would philosophy seek to explicate the *modus agendi* of creative power; not, however, because that is mysterious *in esse* or inexplicable *per se*, but because of the finitude of human sagacity. For mystery does not belong to Nature as an objective reality: it is purely subjective, and real only as a failure of finite intellection. So construed, the ultimate inscrutability of being is no barrier to human intelligence within the precincts of experience, introspective as well as extrospective; nor does it insinuate any impeachment of the claims of science or of the aims of philosophy, nor any disparagement of logical inference from data of experience, however, whenever or wherever found within the domain of consciousness. In this light, mystery is no impediment to philosophy, being cognized as the natural fruit of partial intelligence. It would be strange indeed, if it did not confront rational thinkers, as it does not inferior grades of mentality, and as it does mankind only in proportion to one's ability to explore Nature. Accordingly, it is not strange that we are bound to postulate, prior to our ability to comprehend, —

IV. *The reality of a supra-mundane causal agent.*

Without an apprehension of this truth it is impossible to conceive of force as belonging to any one of the said categories of things; but with it, the concept of its functional issue in the domain of Nature is readily formulated as *the perpetual exertion of crea-*

tive power by the Author of mundane existence, whose abode is literally above, if not discrete from, all that man can know of Nature. And this concept is the only alternative anent the two-fold absurdity of postulating self-existence together with an eternal succession of temporal phenomena. Its authentication in this way is final.

So idealized, *the persistence of force* in the physical world is at once perceived to be, not absolute as insinuated by the diction of some scientific writers, but conditioned upon the volition of its sempersistent antecedent. The Cause of existence is not fickle; and force persists only as the virtual agent of the process of existence, which is perpetuated to achieve the constant purpose of its supernal utilizer. The persistence of force in this sense underlies the seeming passivity and inert durability of Matter, which itself is essentially nothing but *static force.*

It is time to amend the terminology of science in respect of certain phrases which favor the conceit that existing things are somehow indued with inherent perennity, so that a thing once made requires no sustentation, but only to be let alone, to last as long as it shall encounter no antagonism. What else are we to understand when matter or force is said to be indestructible? This accords with the putative axiom that a body once set moving continues to move till some adventitious force prevents, and merely for want of power to stop itself. But in chapter IV. and in chapter XIII, I have sought to expose the fallacy of this *assumption* as it is properly designated, since it is impossible to test its truth by experiment outside the pericosm; while the rationale of momentum, which depends upon a principle wholly extraneous to a moving body, discovers the bastard pedigree of the supposititious axiom.

Science has nearly antiquated the religious belief that "in the beginning God created the heaven and the earth" since when he has merely *suffered* them to exist. But many votaries of science are slow to learn that the Creator of the physical world "worketh hitherto." In fact, most scientists of the present age eschew the *role* of *creation* utterly, in the pristine sense of the word, and credit only Evolution. And well they may, as all disciples of common-sense undismayed by the sway of ecclesiastic authority do that prestigious mode of creation reported of the Hebrew deity, whose *fiat*, "Let there be light," whence light ensued self-radiated, of course applied to all subsequent time,—or would have so applied if the writer of the tradition had apprehended the need of such a purport. Yet, in rejecting the biblical cosmogony, Science must stand corrected by the later-ascertained constitution of light, since as a mode of motion *it stays nowhere*, but is ever-going and ever replaced by that which is ever-coming; in view of which fact, it is impossible to elude conviction that *light is perpetually created.* Alike forcible is the induction upon due reflection that the rotation of the pericosm is perpetuated only by the persistence of force due to the constant exertion of the same power that imparted its prime impetus to rotate. Analogous to this conception is that of certain rotary constituents of Matter, some of which, as atoms of hydrogen, must rotate more than a hundred thousand times every instant. Is it likely that such feats of motion are self-wrought? They are imputable to no other than creative power—the absolute cause of existence. This must antecede existence itself, which, in the exclusive sense of the word that is philosophically available, comprises only the products of causation—*things made to be;* and none of these can be coëval with its maker. The physical world is temporal, and so must be its outcome, though everlasting; whereas the agent of natural causation, conceived as the Cause of existence or Author of Nature, is eternal. Natural causation, *alias* the process of existence, is identical with Nature, which includes none of the attributes, but only and all the acts, of its agent, who must therefore be *super*-natural, as well as *supra*-mundane.

Creation, as fantastically described and dogmatically affirmed by the unknown author of the so-called Mosaic cosmogony, is to be rationally replaced by the theory of *Evolution*, not as hitherto scientistically propounded, without important amendments, according to the discovery that either theory so distinguished contains a residüum of truth. In reality, *Evolution* is true in no other sense than that of *perpetual Creation*. The notion that a *fiat* is equivalent to an *act* of creative power is of course puerile; yet, to ignore the *Cause* of existence and talk of cosmic evolution without a purposing agent, is absurd.

Perhaps the reality of a supra-mundane causal agent of Nature's operations is the upshot of implication ascribable to the Pericosmic Theory. I shall not undertake to show that it purports anything supplemental to this idea. But the four preceding designations of what it connotes are usable as stair-steps to a broader view of Nature than is otherwise attainable. In other words, the direct connotations of the Pericosmic Theory become data for deductive reasoning whereby certain attributes of the *Cause* of mundane existence and derivative purport of superlative *Use* are vouchsafed to human intelligence. What is thus intimated I proceed to elucidate as the concluding chapter of this essay.

CHAPTER XV.

PHILOSOPHY GERMANE TO THE PERICOSMIC THEORY.

To make the subject-matter of this chapter clearly intelligible, it is needful to entertain distinct notions of Science and Philosophy. This expedient has not as yet obtained conventionally in the diction either of literature or colloquy. Recurring to Webster, or any popular dictionary, for a definition of *science*, we are presented with several differential meanings, the most graphic of which is, "certain knowledge;" as if some kinds of knowledge were *un*certain. As to *philosophy*, the most encyclopedic authority represents what was primarily proposed as "love of wisdom" to have degenerated, by commerce of "legitimate inquiry with aspiration after the unattainable," to a final illegimate Babel of metaphysics; since when, the word has become the *sobriquet* for sheer speculative conceit, insinuating the savor of contempt expressed by its derivatives *sophism*, *sophistry*, *sophisticate*. Besides this perversion of an eligible symbol for the superlative compartment of intelligence, its only apparent use in popular literature is equivalent to the *rationale* of things, as the philosophy of vision, the philosophy of sound, natural philosophy, moral philosophy, *etc.*, all such designations being identified with species of science, and otherwise more properly named from their respective subject-matter, as optics, acoustics, physics, ethics, *etc.* The reason for the aforesaid vagary of sages, from Pythagoras to Mansel, is imputable to the fact, yet to be recognized, that Science as the antecedent of Philosophy and Philosophy as the sequel of Science are prospective issues of human progress. We have many special sciences, but as yet no integrant science of the sensible world. What I mean by science as the antecedent of philosophy is, *Discovery of the mundane constitution of Nature*; and what I mean by philosophy as the sequel of science is, *the Teleology of mundane existence.* But here, in the 19th century of ecclesiastical presumption, teleology itself is a problem among scientists, many of whom regard it either as insolvable or solvable only to a negative issue. The most reputable explorers of Nature's physical domain recognize no evidence that cosmic evolution is intermediate to the *purpose* of a causal agent as its antecedent, and an ultramundane *use* as the correlate and consequent of *that.* The problem is foreign to the gist of any special science, and the aggregate light of them all is irrelevant to its solution, without an apprehension of their physical solidarity. Now, the desideratum here suggested is identified with the Pericosmic Theory, the basic postulate of which is the inception of *integrant* science formulated above; and the sequel of this concept is yet to be evolved and conventionally realized as *the forecast of personal immortality* in fulfilment of Hope to the satisfaction of all the rational and moral aspirations of mankind. This is *Natural Philosophy* in the superlative sense of the word—*the* Philosophy correlative to *the* Science of which it is to be the sequel.

But just here I encounter a probable demurrer. To attempt an exposition of the superlative compartment of human intelligence here indicated as a prospective issue of human progress, would be ridiculous. Such is not the subject of this chapter, nor the aim of its writer. Instead of that, it is proposed to furnish a key to the *certainty* (1) that personality is immortal and (2) that all the issues of personal immortality are propitious. To this purpose it is not necessary to anticipate all the elements of life in the alleged ultramundane sphere into which the souls of mankind are born through physical death, but only those akin to personal identity and sympathy which are fairly deducible from the objective claims of Hope. These are determined by such natural wants as may survive the dissolution of the soul's fleshly tabernacle, together with such as may be evolved by its innovated environment, the most imperious of either class being those of the social cast. No conceivable predicament of life in what Faith and Hope are wont to predicate of "the Beautiful Hereafter" would make an acceptable boon of immortality without a prospective greeting of Earth-born associates and the perpetual re-union of kindred hearts inured to reciprocal gratulations. But to see the implication of this fact of individual experience and make the most of it with regard to the subject of this chapter, we must revert to its pedigree, ponder its authenticity, and learn to estimate the logical significance of that.

The last preceding chapter concluded with rational assurance that the Cause of mundane existence is to be cognized as an ultramundane causal agent. This concept is now to be further amended and proximately complemented by corollaries from the organic products of cosmic evolution verging to models of human nature the attributes of which adumbrate those of its projector, whose supreme purpose (as the agent of natural causation whereof cosmic evolution is the mechanical method) may be thence deduced as to the ultimate use of existence *in toto*, so far as the hopeful denizens of its mundane sphere are concerned. In other words, the temporal use of Nature's mechanism is expressly indicated by the organganisms of mentality which culminate in partial developments of personality, from certain attributes of which we may deduce the conceptive *ultimate use* of mundane existence. This condensed statement of the gist and scope of reasoning relevant to the purpose of this chapter is amplified and made effective by means of the following series of logically-consecutive carollaries from the concept of natural causation entailed by the pericosmic structure of the physical world.

I. That the Cause of Existence is sempersistent.

This proposition can be regarded as problematic only by semi-rational thinkers. The moment one has learned to distinguish all notions of *being* as pertaining to one or the other of two exhaustive categories, namely, *things of necessity* and *things of causation*, it becomes self-evident that these are also distinguishable as *temporal* and those as *eternal*; from which it follows by inference *impromptu* that things of necessity have neither beginning nor end, being absolutely persistent without a cause, whereas things of causation *must* have a beginning and *may* have an end, nay, *must* have an end whenever the agent of their causation shall cease to sustain them. For the products of causation have no more power to perpetuate than to initiate their existence, and self-existence is no less absurd than self-creation. In fact, the noumenon of existence is perpetual creation so long as a thing of causation endures. The rational concept even of creative power comprises no ability to produce a self-sustaining entity; and every atom of Matter, as well as the pericosmic atom, together with the rotary motion of each as respectively indued therewith, persists only as and while it is *made to persist* by the constant volition of its perpetual creator. Such is the modality of existence, and there is no other. But in this sense things of necessity do not *exist*: as absolute realities they *sempersist.* It is ridiculous to query as to the origin or the modality of time and space, or whether there be a world wherein two and two do not make four. God is no more the maker of the 47th proposition of Euclid than was Euclid himself. Yet so *free* a thinker as Col. Ingersoll in one of his religio-querulous lectures näively asks "Who made God?" The obtrusive absurdity of the question determines its intuitive answer. A maker of infinite things is impossible. How much wiser than Ingersoll, then, specifically, are some of his theological opponents who postulate the *self-existence* of God? That whic his never *made* is not *self*-made. "*Scientific Theism*" will not always cherish the notion that "the Universe, as an infinite organism, is self-existent." The fallacy is more lingual than ideal. Words are symbols of thought. Accurate conception is vehicled by apposite expression; so the conception of *sempersistence* must antecede the teleology of *existence.*

II. *That the agent of natural causation is supernatural.*

This proposition is a corollary from the preceding. The word *nature* is appropriated to the products of creative power, apart from the domain and attributes thereof, tallying in scope with the word *existence,* which (as determined by its co-equal symbol) includes the process and products of causation, both natural and connatural, but nothing else; and either word is illegitimately applied to things of necessity, which are not *of* Nature, but absolutely discrete from it, not only as preceding, but also as predetermining, the physical constitution and aptitudes thereof.

Necessary truths are conceivable negatively, not as *un*-natural, but merely as *other than* natural. They are also cognizable positively as potential elements of Nature's *regime* prior to their concrete existence as *laws* of Nature, in which relation they become *con*-natural. This statement applies to all things of necessity save the modality of creative power, and includes the acheivements even of this. That is to say, all necessary truths are *ordinately natural* except the agent of natural causation, who is exclusively *supernatural*; the *exercise* of creative power, which in the superlative sense of the attribute is measured by the precincts of possibility, being *pre-ordinately-natural* in accord with all necessary truths.

But the reality of absolutely-creative power itself is questioned by many scientific thinkers, some of whom regard it as fabulous. Mr. Spencer, however, repudiates only the figment of *instantaneous* creation, and maintains cosmic evolution; not as spontaneous, but as the process of an inscrutable agency; and this is equivalent to diuternal creation. That the negative postulate "*ex nihilo nihil fit*," often mouthed with confidence by atheistic theorists, refutes the fact of creation or power to create, is a metaphysical conceit. Its fallacy consists in calling *nothing* a *thing*, which, instead of being made from nothing, is not made at all. Everybody *but* metaphysical querists knows that things *are* made in the very sense that the word *create* is meant to signify; that is, what has not existed is made to exist, even by finite agents of connatural causation. But the agent of natural causation makes all the *means* by which connatural causation is effected, including its agents; makes them, not out of nothing, surely, but by means of the inherent sempersistent resources of absolutely-creative power, all of which, as constituents of its modality, are supernatural. So conceived, the theory of evolution is no bar to creation: it is the mode of executing the *fiat* of creative power; which, to be effective, must be as lasting as its products. According to the Pericosmic Theory, the two corporeal constituents of physical existence,—the Ether and Matter,—are made of Force, the static and motoric phases of which are born of the perpetual will-power of Nature's omnipotent Soul.

The only alternative to this deduction is to postulate the eternity of Matter and the Ether which implies their self-creation; it being demonstrable that they are not things of necessity. There is no halting between this absurd and that rational conclusion.

III. *That the achievements of creative power are voluntary.*

Every agent of connatural causation is consciously free to act or not to act, in any practical way proposed for deliberate determination: and in this predicament, one never decides to act without a motive identifiable with some apprehended phase of conceptive *use*, or means of gratification, which consists with the conscious attainment of something sought and found only with endeavor. All the productive arts of mankind are practiced in virtue of their respective availability to personal welfare, the solidarity of which, enforced by reciprocal wants and mutual dependence for their correlative supply, co-ordinates duty with interest, in favor of the compensatory benefit and satisfaction of each practitioner. And this alliance of each to all in every species of animal life, as a means of human development, pertains to the process of natural causation, the agent of which cannot be supposed unable to enforce allegiance to its moral principle. Yet the universal disloyalty thereto in the primeval stage of human development, as well as the reckless conduct of many living persons, making civil government with its judicial appendage to legislation necessary to social order,—making courts and jails and reformatory schools essential to restraint of crime,—demonstrates the free-agency of mankind, many of whom *will* not do as they ought nor forbear to do as they ought not, without political coërcion, or till *as freemen* they have learned by experience, or at least by observation, the better economy of equity; or else, through inherited traits of ancestral self-culture, have come to savor the amenities of fellowship, assured that self is naught without society.

But the free-agency of mankind is conditional, as well as limited. Our liberty to act against the sentiment of obligation, as instigated by abnormal propensities or inveigling circumstances, is merely *license*, the price of which is always exorbitant. If we do wrong, either wilfully or inadvertently, we must suffer the consequences of misbehavior, which are instinctively regarded as penal, though reason assures us that they are purely reformatory.

Now, the drift of inference from this summary of the predicaments of connatural causation is determined by the reflection that they are all comprised by the process of natural causation. This makes the temporal issues of the latter contingent upon the voluntary agency of the former. By this means, the mundane products of natural causation are fraught with evil; and the exercise of creative power must, therefore, have been preceded by the choice of its agent between tolerance of human frailty for a season for sake of realizing the forecasted *use* of mundane existence; or foregoing forever its probable supernal avails. There was no alternative to this dilemma, as it would seem to finite conception; since all the constituents of cosmic evolution are concrete exponents of necessary truths. The projector of human free-agency must of course *be* free, but only within the precincts of possibility; and while the exercise of creative power is optional, the extant process of natural causation is exclusively practical. Hence the presumptive inference is, that creation by a process involving a comparatively-transient era of evil was made acceptable to Supreme Wisdom by its exclusive fitness to evolve a transcendent good. This presumption is justified by the succeeding proposition and its logical sequence.

IV. That the temporal use of mundane existence is indicated by the climax of its consecutive issues.

These represent gradations of mentality culminating in *personality*, which thus proves to be the objective aim of Nature's Author. That is to say, the physical structure and mechanic forces of Nature, with all the animated scenery of the human world, exist for no other end than the birth and education of finite persons. But it is an obtrusive fact that this object has as yet been but partially realized in the terrestrial world; and though it is likely to be fully realized in time, yet it is scientifically ascertained that after many millenniums of human maturity, this planetary world itself will perish by collision with the Sun. In that event, will there be no other sphere of conscious existence to which Earth's inhabitants can migrate? If not, what is the *use* of their birth and education? and if there be a place of refuge for them, — the last generation of adult humanity, — is it not more likely that there has always been an ultra-mundane sphere of life whither the myriad generations of mankind have gone to verify *the ulterior use of their earthly career?*

V. That the Author of Nature is intelligent.

One of the curiosities of human nature is the affectation of some metaphysical writers and the tacit assent of certain scientists that there is no proper evidence of this truth. It is the conventional judgment of mankind, however, that it would be more reasonable to question the reality of finite intelligence. Pope's couplet —

> "*All Nature is but Art* unknown to thee,
> *All chance direction* which thou canst not see," —

differs from science proper only as it savors of philosophy proper. To ordinary human observation, Art may seem to take precedence of Nature by its implication of practical intelligence; but normally apprehended in the guise of superlative art, the phases of Nature are recognized as indications of supreme intelligence. Art comprises the chief practical fruits of intelligence. But though ostensible art seems to complement Nature, it is only by means which Nature has evolved. Thus Nature is the parent and prototype of connatural art; and lo! Nature comprises the very implements and agents of all finite art, intelligence and all the artistic aptitudes and capabilities of connatural artists being identified with the hands and brains of Nature. What kind of a philosopher is that who claims for himself the attribute of intelligence, yet queries whether or not the begetter of his intellects is intelligent?

The blindness of many so-called naturalists to the lineäments of consummate art in the mundane constitution of Nature and in its appurtenances, or their failure to discern therein indubitable indications of ulterior intelligence, is largely imputable to insinuations of spontaneïty in "the course of Nature" by the terminology of science, many items of which are traductively polarized to drifts of antiquated misapprehension. Allowance is consciously made for the illusive suggestion of a few exclusively-scientific terms, like *solstice*, *tropic*, *solar* and *sidereal* periods, *etc.*, more commonly than in respect of the phrases "persistence of force," "indestructibility of matter," "attraction" of particles, "self-evident" truths and "intuition" of truisms. The word *evolution* is literally fraught with the purport of autogenous effectiveness, in logical accord with the saying of Topsy in *Uncle Tom's Cabin*, — "'Specs I growed;" a sentiment fully conventionalized and provincial only as to its diction. Probably, few even of cultured persons have learned to eschew the näive belief that all sentient beings are products of *birth* and *growth*. Who beholds the phenomena of *vegetation* with any surmise of its being the exoteric work of an esoteric intelligence? Nobody — except in rare instances of meditative insight. Yet, there is no other alternative to the unwitting assumption that the physical constitution of Nature is a soulless combination of insentient (and therefore irresponsible) mechanic forces.

Is the proposition, *Plants grow*, any more suggestive of creative power than the saying, *It rains?* Probably not. Yet it requires but a moment's reflection to perceive that the dropping of water from a cloud involves only certain modifications of physical force, whereas growth is a *method—a combination of forces guided to a special purpose.* The one phenomenon is purely physical and mechanical; the other is physiological, that is physical *and* vital. Hereby is suggested a twofold functional agency in vegetation, distinguishable as the *effective* and the *directive* — a *power* subservient to *discretion.* Thus the phenomena of vegetation betray the intelligence of its unseen agent.

Betray! — Is it not a ridiculous characteristic of finite intelligence which makes the said betrayal possible? Does it not also betray human stupidity — this inveterate slowness to draw the inevitable inference from such glaring premises? Not without a salvo. Doubt is cognition's harbinger. All men are conscious of knowing something, while none is quite foolish enough to think oneself the originator of cognoscitive faculties. Yet few are wise enough to perceive that the agent of all finite intelligence is to be identified with the Cause of existence *in toto.* For the pith of knowledge is *conviction*, every expression of which is an item of experience, not an *act*, as one may fancy; and experience is that to which sentient beings submit, not what they achieve. So consciousness, including all modes of intelligence, is as much a product of creative power as any existing thing. In the light of rational conception, the *ego* of mentality appears to be incapable of knowing anything intuitively. The notion of intuitive perception is fallacious, and no truth is *self*-evident. Sentient beings who are made to exist are also made to feel and know. The Author of Nature is the *active* and the finite *ego* the passive agent of *conviction*; and in this sense all finite intelligence is suscipient. The like is true of all sensations, or rather of all the predicaments of consciousness on which sensation depends. It is obvious that sentient beings have as little control of the physiological processes on which animal life depends as plants have of those on which vegetal life depends; and it is only for want of reflection if it is not as obvious that we are not efficient agents of either feeling or cognition. If we were, should we ever tolerate excruciating pain or unwelcome intelligence? Guessing is voluntary, and so is belief; but knowledge is imperious. We believe, or disbelieve, at will; but what we know, we know perforce. And this fact is in no wise unpropitious. Its recognition is exceedingly important, relevant as it is to the rational authentication of suscipient knowledge. For, if the *ego* of consciousness is not the agent of finite intellection, then this must be an item of natural causation, and suscipient knowledge is the finite expression of supreme intelligence, equivalent in kind to that of its superhuman agent, who is the incumbent of all wisdom as well as of all power.

Thus the figment of *relative* knowledge in the metaphysical sense of this epithet is quashed, and Pyrrhonismic skepticism is effectively forestalled. Common sense is no longer traducible as precarious and fraught with uncertainty, all its elements being ratified as items of divine revelation. Henceforth, be it conventionally understood that there are no gradations of certitude pertinent to the subjective modes of cognition. A dog knows as well as a man when he is hungry, and that a bone *is* a bone. And would-be philosophers may now be as well-assured as ordinary observers of the reality of the external world. Moreover, sages will now be as pliant to conviction as brutes and boobies have always been ; and the former will no longer wait for "the consensus of the competent" to ratify a verdict of common sense or of logical inference ; what everybody says being no more authentic then a single thinker's *inability to doubt.* This is the infallible guide to unerring discrimination between *knowledge* and *belief.* It does not *dis*-prove the objective verity of belief, but it demonstrates the validity of knowledge. For while it is easy (in some cases) to believe what is not true, one cannot ignore what one knows. But how shall I *know* that I know? Only by trying to disbelieve what I know. Doubt, in this predicament, proves only lack of knowledge ; but *inability to doubt* presages reality. Every ignoramus may doubt of the Earth's rotation, but no astronomer can. So when I try to believe there may be a world wherein two and two do not make four, I find such belief impossible ; and my endeavor to conceive it possible results in conviction of its falsity ; *conviction* not by volition of *ego*, but by *fiat* of the one creative power whereby the world of finite consciousness is sustained.

VI. *That the parent of mentality is Infinite Mind.*

It would mask the sense of this proposition to regard finite and infinite consciousness as homogeneous. Whatever is infinite is indivisible. It is impossible to segregate, even in thought, a portion of time from eternity or a portion of space from ubiquity. So it is impossible to abstract *a portion of Infinite Mind*; but that is precisely what the term *finite mind* literally signifies. Therefore, I reject the misnomer and employ the word *mentality* to represent the gradations of consciousness from protozoa to mankind. These are all products of natural causation, individually progressive by virtue of experience, which inchoates with the germinal degree of sensation and advances with ever-widening scope beyond any known limitation of rational and moral development. Mentality ekes to personality, of which there is but one constitution, and this is as yet but partially developed and imperfectly represented by the most notable of mankind. The prospective maturity of human personality is predicable only of the diuternal experience of the race, that is the conventionalized issues of individual experience transmitted by successive generations. Every species of finite consciousness is a suscipience of superhuman consciousness the mode of which is individual and social experience. But experience itself is possible only to an aboriginal selfhood, the very germ of which is cognized as *ego*; and *this* is an offspring of the sempersistent analogue of ideal personality. What name shall we give to the *parent* of those personal attributes which to contemplate as infinite surpasses all other incentives to adoration—the antitype of Man, not as he is, but as he aspires to be? We call it *God*; but this word has been polarized to misconceit by ecclesiastical usage. To express it as "the Eternal not ourselves who makes for righteousness," is more ethical than any religious appellation, by suggesting an incentive to reverence without a savor of awe, which is foreign as well as offensive to natural piety. But if we add a word more, and call it "the Eternal [*Mind*] that makes for righteousness," we derogate nothing from Mr. Arnold's apothem, but supplement its significance by discovering, not what may dispel the mystery of *being*, which Spencer calls "the Unknowable," but what is intelligible and edifying as to the paternal character and beneficent policy of the Creator and Sustainer of our sentient world.

Mentality as defined above is precisely what is commonly understood by the word *mind*. Spencer in his *Principles of Psychology*, says: "Mind, as known to the possessor of it, is a circumscribed aggregate of activities; and the cohesion of these activities, one with another, throughout the aggregate, compels the postulation of a something of which they are the activities." This description of *mind* occurs in a chapter entitled "the *substance* of mind," which Mr. Spencer discriminates from *mind* itself, and argues the inscrutability, not of *mind* or *mentality*, but of "an underlying something" of which he says "we know nothing, and never can know anything about it." Thus, what he calls "the Unknowable," the reality of which we are compelled to postulate, he virtually identifies with the Cause of existence, or agent of natural causation; and what he conceives as the *substance* of mind is what I have called the *parent* of mentality, the procreator of all finite consciousness, the gradations of which are so many modes of experience whereby mentality matures to personality. This finale of natural causation, or culmination of cosmic evolution, betokens the character of its supernal agent, with rational insinuation—

VII. *That the attributes of Infinite Mind are essentionally personal.*

Personality is the climax of mentality, born of Infinite Mind only through experience, the broadest scope of which is that grade of consciousness which embraces the quota of personal aptitudes adequate to a normal selfhood. These are the paramount attributes of conscious well-being, the incumbent of which can have no alien rival. As predicable of finite personality, they must be the same in quality as is imputable to Infinite Mind, which is correlative to mentality as cause to effect. In character, this must simulate that—the moral attributes of personality must resemble those of its parent and be distinctive therefrom only as finite from infinite; though *in esse* the one differs from the other as natural and supernatural, existent and sempersistent. So conceived, the characteristics of the Infinite Mind are indistinguishable from those of *the Supernal Person*, who, it is deductively certain, " makes for righteousness " only because the elements of his character comport with those of ideal human perfection. This is not what anti-theologists deride as " anthropomorphism," since it presupposes nothing as to the *form* of the Infinite Mind, or as to the prospective *form* of any immortal *ego*. But it does presuppose, and affirm positively, the likeness of every matured finite personality to its superhuman parent, in respect of rational and moral proclivity; and *this* may be pedantically styled " anthropoidism" without a cavil or a slur.

As an animal is superior to a plant, so is a person nobler than a brute. If then the Author of Nature be conceived as the Infinite Mind, it improves our conception of that to regard it as the superhuman paragon of personal perfection. This concept excludes the notion of sex, which is a sheer animal endowment of mankind, to be cast off with the mortal part of human nature.

It is only to personality that moral character is imputable; and without moral character no entity is rationally adorable. The antique worship of the Sun was only as real and lasting as its personification; and the Hebrew worship of Jehovah was hardly more ennobling or edifying than the Egyptian worship of the Nile. But mankind have never been so foolish as to render praise or blame to what they deemed or recognized to be impersonal. When they have idolized objects of their own making, it has been only through these that they have proffered obeisance to occult personages. So the Author of Nature is contemplated with reverence only in the guise of supreme personality. Therefore, to deny the personality of God is equivalent to atheism; and atheism knows nothing of a human hereafter. It is only on the personality of Nature's Author, as the base of his eternal rectitude, that we can build authentic evidence of our immortality. And now, having discovered that the parent of mankind is a person, it is of great consequence to ascertain what kind of a person he is—what is his moral character. We have seen that he is intelligent—supremely wise; that he is the incumbent of omnific power; and that his achievements are voluntary. We are interested to know furthermore, if he is just, magnanimous—*responsible* for what he creates and for the issues of his achievements. *Is the sovereign of the universe a trustworthy disposer of all human interests?*

There have been diverse speculations in answer to this question, both sacred and profane, rational and fantastic. Does the Author of Nature appropriate *any* of the flippant appellations of deity, comprised as they all are by religious misconceit, which smirches every page of so-called sacred literature? Is the Eternal Person to be conceived as a monarch, such as Jonathan Edwards proclaimed, whose *will* transcends all notions of natural or supernatural *law?*—to whom the psalmist could say with propriety, "Thou art to be *feared;* and who shall stand in thy sight when thou art angry?"—who, as Paul declared in the *animus* of his own domineering propensity, "has mercy on whom he *will*, and whom he *will* he hardeneth?" No!—the Infinite Mind is not the analogue of Henry the Eighth, Napoleon Bonaparte, or Alexander the Great,—not the God of Calvin nor Jehovah of the Jews, any more than Jupiter or Bäal of more ancient superstition. One school of mythology is as idolatrous as another. But how distinguish this from the better phases of theism? There is but one criterion. It is that which one can "worship in spirit and in truth." Is the parent of mankind such as Jesus of Nazareth propounded, in whose vision of human destiny appears the face of our *Father in Heaven?* Yes!—all but the masculine gender. In general terms, the gospel preached by Jesus, as aforetime preached by Isaiah, is *the* Gospel of Reason and Righteousness. But this assertion, though in perfect accord with the foregoing propositions, is what remains to be demonstrated, deducible as it is from the following.

VIII. *That the super-human person, as agent of natural causation, is supremely responsible.*

Responsibility, in the ordinary sense of the word, is not predicable of any grade of mentality below the personal; and in a special sense of the word it is imputable only to normal developments of personality, I am not sure, however, that the conventional demarkation between the personal and the subpersonal forms of mentality coincides with the physiomorphal distinction of mankind from brutes; for I have known many a quadruped more amiable and morally-respectable than certain individuals of the *genus homo.* Now and then a dog or horse is more responsible for achievements pertinent to their respective spheres of action han here and there a counterfeit man. When Jesus asked his disciples to consider "how much better is a man than a sheep?"—he knew that common-sense had already answered, "that depends on how they both behave." The interrogation was meant to prompt the reflection that character is a thing of conduct. "Handsome *is* that handsome *does.*" This proverb is a cue to the purport of responsibility as a trait of magnanimity, which forestalls the presentiment of retribution as well as the sentiment of obligation. Our inability to designate with scientific certainty who, if any, among the comparatively few exemplars of human rectitude whose memories are cherished with emulation, have attained the prëeminent degree of personal responsibility, does not frustrate the concept of its reality as a prospective attainment even of all mankind. Nor does it check this latter presumption to be assured that the majority of our ancestors, and even of the living exponents of human nature, are responsible only in a qualified sense of the epithet. The truth still remains that every sentient being *is responsible*, in the sense of being *amenable to the law of conscious well-being*, each in proportion to one's capability for self-conduct.

Conscious well-being depends on what Spencer calls *life*, namely: "The continuous adjustment of internal relations to external relations" (or partly this and partly its converse); which, however, is not *life* but *the law of life*, conformity to which results in well-being, and non-conformity or partial conformity to which results in ill-being, if not in immediate death. Life is identical with conscious existence, the elements of which are products of natural causation; and the agency of this includes that of life's process, all but what is pivoted by the free-agency of sentient beings. And herein is vested all that is conceivable of personal responsibility, the most general notion of which is the predicament of being obligated to perform some voluntary act, or else to suffer an adequate penalty for its non-performance. Such, in fact, is the predicament of all sentient beings of whom free-agency is predicable, but of none else. But no being can be morally obligated to do what ought not to be done. Furthermore, the law of righteous action is restricted to what is individually-known to be right, though the tutorage of experience includes many *quasi* penalties to reclaim its subjects from error and unwitting wrong. And it is very conceivable that the diverse physical chastenings of animal license entailed by the aberrance of sub-rational mentality constitute an inferior species of responsibility which serves to nurture individuality from brute to human. But personal responsibility is based upon purely voluntary action, and that of mankind is resolvable by analysis into two special incentives to self-conduct, in allegiance to the law of conscious well-being, to-wit:

(*a*). The predicament of being self-bound to do right in any given case, merely to evade the consequence of doing wrong.

(*b*). The predicament of being self-bound to do right in any given case, regardless of the evil that would ensue from wrong-doing, and for very love of duty as the counterpart of interest.

These two incentives to self-conduct pertain to mankind integrantly, individuals differing from each other, morally, not by contrast, as good and bad, virtuous and vicious, righteous and wicked, but by gradation, as more or less virtuous or vicious. The ecclesiastical notion that every person is either a saint or a sinner is unscientific; but less enormous than the dogma of total depravity, which, however sacred its pedigree, is repugnant to common sense. But no person is always in the same moral predicament, or subject to the same incentive to self-conduct; and it is not demonstrable that perpetual loyalty to a sense of duty, from youth to age, has ever been realized by the noblest of human livers. The moral predicaments denoted by *a* and *b* represent two phases, or two grades, of personal *responsibility* in the better sense of the word, equivalent to *trust-worthiness* to fulfil an obligation. It is only in this acceptation that responsibility is voluntary, or pivoted by personal free-agency. This, however, is not the primitive sense of the word, which often stands for sheer *accountability*, with no guaranty for the fulfilment of an obligation, but only the assurance that delinquency or defalcation will be requited with punishment. But constant frowardness has never been personally exemplified. As perpetual loyalty to truth and right is not demonstrable as to the best of philanthropists, so perpetual disloyalty to obligation is not imputable to the worst of criminals and despots. Even the so-called lawless are often persuaded to do right in view of the meed of well-doing, as well as dissuaded from wrong by apprehension of its penalty. It is only for special acts of trespass on the rights of others that a disreputable citizen is outlawed. That is to say, all mankind are more or less responsible in the optional sense of the word, but equally responsible in the primitive inoptional sense of the word, that of being inevitably *accountable*, or *amenable to the one law of conscious well-being.*

But conscious well-being depends upon character. As this is progressive, so is that. It is not attainable in childhood in the same degree as in manhood. Brutes, incapable of realizing those elements of rational and moral sensibility which ennoble humanity, are not annoyed by a sense of inferiority to mankind, and therefore are content with a measure of well-being which human nature could only endure as a form of ill-being. This is because the *wants* of brutes are less numerous and various, less expressly-exquisite, than those of mankind. What, then, is the *law* of conscious well-being? It is this: *The objective supply of all natural wants.* In this predicament, and in no other, every soul is satisfied. The general appellation for this predicament is *Happiness*, which as here defined is "the end and aim" of every conscious liver. There is no other conceivable *use* of being as a whole, and no other gist of rational desire to live in any sphere, but to live well; and to live well is to find what we seek — to have what we want. It is important to observe, however, that the natural wants of mankind are mutually restrictive; and this is a prëeminent reason for their collective satisfaction. In the mundane sphere of life, most natural wants— all save those of a spiritual bent — are limited in capacity, and their over-supply is pernicious. The *animus* of physical appetites is curbed and appeased by the superior suavity of intellectual and moral aspirations. These determine the bent of individual endeavor in accord with the drift of personal development, in the upshot of which every soul is destined to learn by happy experience what is *the use of Being.* We call it *Happiness*, the boon that all are bound to seek, but none appears to find — to satisfaction. Wherefore? Because it is possible only as the outcome of human maturity, and humanity is young. The history of human progress from barbarism to civilization connotes an approaching *age of virtue* wherein all mankind will realize the harmonial objective supply of all natural wants, even on Earth; and Hope descries beyond that sublunary era a supersensuous heaven of deathless humanity. But inasmuch as social wants are imperious and proportional to human development, the welfare of each depends upon the rectitude of all. Therefore Happiness is not to be found, and should not be sought, as the immediate, but only as the ultimate, "end and aim" of personal endeavor; and *this* not for self merely, but for all as the cöeval counterpart of each. Accordingly, prior to the era of human maturity, the practical rule of self-conduct must be the fitness of any act or course of action to subserve the paramount use of mundane existence, to wit: *Human development*, including selfhood and society — that as the tenant of this, society as the *alma mater* of selfhood.

"*The main thing in life is to grow*," that is, to be personally educated, now and here, in order to become capable of a life worth living hereafter. Whatever premeditated act, or optional course of action, or suggested motive to endeavor, is relevant to this superlative object of life in this world, is *right;* and whatever is adverse to, or inconsistent with, this divine purpose which every climbing soul was born to realize, is *wrong.* Voluntary allegiance to this eligible rule of self-conduct is the acme of human responsibility. But how does this induction relate to the assertion that the supernatural agent of natural causation is responsible? Precisely as the minor premise of a syllogism relates to the major premise thereof, exacting a logical conclusion. That is to say, the Author of Nature and Parent of Mentality is the paragon of human development, and mankind are more or less responsible in proportion as the attributes of human personality are unfolded. Therefore, in virtue of personal perfection, the Parent of Mentality is supremely responsible.

This thought pertains to the core of ethics. The rationale of moral responsibility as native to normal personality is the sensible conciliation of duty and interest, which thus appear to differ only as two phases of a single principle, namely: the congeniality and functional co-ordination of selfhood and society. These are the two pillars of the moral arch whose keystone is mutual dependence. Society is the maker of selfhood, and selfhood is the make of society. Society apart from selfhood is *nil*, and selfhood apart from society is naught — an intolerable evil. The twain are born together, and of each other, to one and the same purpose. Their duty to each other is fraught with the interest of both, and their welfare is cognate, insomuch that no member of a community can be completely happy till all shall be.

Without responsibility self-approval is impossible; and self-approval is a source of enjoyment far superior to the gratification of any physical appetite. Responsibility is also the base of social commendation, which is almost as satisfying as self-respect. Moreover, personal development is the base of sympathy, the richest source of enjoyment known to human experience. Out of sympathy comes fellowship, friendship, interchange of thought and affection, communion of heart with heart, and generosity, the bliss of giving, which is more propitious to benefactors, if not to beneficiaries, than the luckiest of Fortune's favors.

The highest grade of personality consists with the most numerous, most complex, most exigent and most efficacious of personal wants; and of gratifications, on which conscious well-being depends, the social are the most delectable and lasting, though self-respect, intellective achievements, and the sanction of deeds by conscience as well as by reason, are sweeter than honey, more enduring than amative emotions, and more satisfying than conventional eminence or popularity born of place or power or affluence.

The higher the grade of human personality the more responsible is the person. Why then should not the author of human nature, the Supreme Person, be supremely responsible? If the best of mankind are most self-bound to do right, can the Infinite Mind be self-licensed to do wrong? Absurd. Moral accountability must be proportional to personal ability. To whom, then, is the incumbent of creative power amenable? To himself, and to none else. Does anybody imagine that self-judgment may be an inadequate tribunal of self-conduct? Self-judgment is, in fact, the only ethical judgment, and its verdict is inevitable as well as supremely effective. See its issue in the case of Judas. Ponder many a later tragedy of self-wrought vengeance, such as William Gray, jr., enacted when he judged himself to be a defaulter. The day of judgment will come at length to every soul, however it may seem to be postponed during one's earthly career. By means of self-judgment every survivor of physical death will be rewarded according to the works of each as recorded by ineffaceable memory. Then will the worthy learn to prize complacency. Then will the guilty learn the sway of remorse. Self-judgment is a predicament of psychologic necessity. No grade of personality can escape the ordeal which it imposes, not even the parent of mankind, who is subject to the same law of conscious well-being as we, that is *well-doing in proportion to ability*. But God's eternal love of well-doing *impromptu* is the harbinger of his allegiance to that, and this is what constitutes the tribunal of his self-conduct which pre-determines his supreme responsibility.

IX. That evil is not a product of natural causation.

According to the foregoing argument, the better traits of humanity hitherto developed and now extant foreshadow an era of human maturity when the spiritual attributes thereof will incipiently personate those of the deity. In that era, though man's physical wants will be more readily and completely supplied than at present, yet these will be surpassed and made subservient to social wants and spiritual aspirations. Egoic gratifications will then succumb to convivial, and it will become "more blessed to give than to receive" aids to emolument. And herein human personality will best reflect the divine; for, though in human ethics self-love is the measure of social love, it is inconceivable how the giver of all finite good can have an inkling of self-emolument in working for those who can never recompense him. But as maternal love has no price for nurture, so the parent of mankind is no hireling, nor yet an idler, but a voluntary benefactor whose consummate want is the perpetual well-being of his aspiring and hopeful progeny.

But anent this pious sentiment, it is reasonable to heed this obtrusive query: If God is benevolent and wants his human offspring to be happy, why does he suffer so much misery to be endured in this world as all are conversant with, by experience as well as by observation? Why does he not make mankind happy to-day? The only rational answer is, Because he cannot prevent the calamities incident to human life, consistently with the use of living here, which, as aforesaid, is the birth and inceptive education of mankind, whose primary school is sublunary experience. We are temporary pupils of experience here that we may become susceptible of perpetual enjoyment hereafter. But in order to be pupils of experiience to the issue of personal development, we must be incumbents of self-conduct. This is an art the normal practice of which requires intelligence. Yet man was born an ignoramus, and left to learn the art of living well by means of free-agency without intelligence, reaping the fruits of blind endeavor in all feasible ways of living. Thus error has ensued from ignorance and evil from error. The orderly course of Nature depends upon certain mechanical, chemical and other physical principles, which being of necessity, are invariable. In so far as our conduct accords with these principles, called the laws of Nature, our experience is genial and we call it good; but when we make mistakes, the issues are what we call evil, a portion of which is thus accounted for. It were easy to demonstrate, however, that the evils which ensue from human depravity greatly exceed in enormity and severity those which ensue from human error; but then, depravity itself is entailed by error as is error by ignorance, which, in wedlock with incompetent free-agency, is the grandsire of all the self-wrought pests of humanity.

To this two-fold category of sublunary woes pertain much more than a moyety of all that flesh is heir to. Yet the fact remains that, though the larger part of human suffering is *quasi*-selfwrought, through ignorance and depravity, man is the occasional victim of certain catastrophes germane to the course of Nature, for which he is in no way responsible. To this class belong volcanic eruptions, earthquakes, tornadoes, untimely frosts, drouths, pluvial deluges, conflagrations and demolitions by electric commotions of the atmosphere. When such phenomena occur apart from sentient forms of life, they are harmless, and are noted as freaks of Nature with no omens of disaster. It is difficult, indeed, if not impossible, to conceive of their respective utility, except in the aspect of fortuity, as when a thunder-storm, in wrecking now a ship and then a church or homestead, works healthful changes in the air and waters the soil of vegetation. In such events there is no more appearence of design than of casualty. An all-wise over-ruling providence, if relevant to their contingency, should not even permit their occurrence. There is but one way to account for the adverse facts. They are to be rationally-cognized as inevitable ef fects of the ever-changing relation of the Earth to other planets and to the Sun. In other words, they are issues of physical necessity, as natural, or rather preter-natural, as is the sequence of day and night, or of summer and winter, which depends on the Earth's varying attitude toward the source of its adventitious light and heat, by virtue of its orbital and rotary motions. See how the ocean-tides accord in flux and reflux with the varying course of the Moon. See how the Moon's phases tally with its varying attitudes respecting the Earth and Sun. Say, why are the Earth's polar regions perpetually frigid and lifeless? Why is the Moon itself completely dead, destitute of water and all the elements of vital phenomena? There is no fluid water in the Moon because all its ancient rills and reservoirs thereof are turned to solid ice, in consequence of the continuous dissipation of its indigenous heat, which was thus long ago exhausted; its alternate two weeks of sun-shine and two weeks of exclusive thermal radiation being doubly antagonistic to its resuscitation. In the one predicament, life in the Moon would be extinguished by excess of solar heat; in the other, by congelation and stricture of life's elements. It thus appears that the Moon, as a habitat of plants and animals and personalitities has had its day; for it certainly has been a theater of serial metamorphoses as favorable to biologic developments as is predicable of the Earth's polar regions during millions of years prior to their present defunct condition; and it is exceedingly probable that life on the Earth was first evolved at the poles, where the Earth's indigenous heat was first sufficiently abated to admit of the evolution of life's organic forms.

As the moon has not always been dead, so the Earth's polar regions have not always been devoid of life, and comparatively inutile as now; neither has the intervening surface of our terraqueous world, in all past ages since life appeared at the poles, been utilized to the same immediate purpose as now. During all the millenniums of organic evolution at the poles, the Earth's equatorial region was fraught with vehement heat, generated by the play of its basic atoms in effect of their gravitation, postponing the birth of vegetable and animal forms of life between the tropics, as well as the transmigration thither of the arctic and antarctic aborigines of our planet, whose one finally-habitable zone is now tenanted by their hybrid posterity. Is anybody foolish enough to ask *why* the whole surface of our planet was not utilized as the home of mankind at once? It could not be. What would seem to have been most economical in point of time and space and motive energy, was, in fact, impossible. Is there any other reason why two-thirds of the Earth's surface is incessantly occupied by water? or why the bulk of our *terra firma* is inaccessible to its inhabitants, not admitting even of exploration in accord with the legitimate aims of science? Not every desideratum of human conception is feasible, and none is to be compassed without means, even by the agent of natural causation. God can neither make nor unmake a thing of necessity, either discrete or concrete. This is the pivot of all such disasters as are adverted to above. When a house takes fire by night while all its inmates are asleep, why does not providence wake them up before they are consumed? When a storm at sea is raging, why does not creative power rescue the mariners who are sometimes tossed by wind and wave to sudden destruction? When a carpenter slips from the roof of a lofty edifice, why does God let him fall so helplessly as to mangle his body it may be to death? It is futile to ask such questions unless we multiply them to completion of the catalogue of physical calamities. Say, then, at once, Why does God help only those who help themselves? The answer is ready: Because self-conduct is the only means whereby mankind can be educated; and self-conduct without prudence *must* be obnoxious to disaster.

But the problem of evil as a whole is not thus to be solved. There are evils of a more mysterious source which are apparently inexplicable. When we recollect the multifarious species of vermin that infest vegetation, we wonder what such creatures are good for. We perceive only mischief in their employments, and hesitate to regard them as products of natural causation. When we consider furthermore, how most of our domestic animals are pestered with parasites, our wonder is heightened to astonishment. Why should the paunch of a horse become the habitat of bots, often to the risk of that generous animal's life? Why are cattle generally annoyed by hungry insects and preyed upon by lice? Nay, tell me rather why several pestilential diseases of mankind are identified with diverse swarms of noxious microscopic grubs that burrow in human flesh; and then I may be able to divine the common source of more than thirty species of parasites which, from first to last, have been detected in making inroads for plunder on the skin, in the intestines and among the tissues of the human body. Then another aspect of the question obtrudes as to the apparently-intended use of stings as implements of warfare ancillary to wasps, hornets, asps and adders. What signify the poisonous fangs of rattle-snakes, the condar's talons, the weapon of a sword-fish, or the equipment of ferocity as displayed by lions, tigers, leopards, and numerous beasts of prey? No humane person can read certain chapters of natural history, or contemplate the conceptive scenes of cruelty and diobolical carnage which they suggest, and not revolt with rational and moral disgust. Is it pleasing to contemplate how commonly one grade of animals subsist upon the murdered members of a less athletic but more amiable grade?—spiders by decoying flies, cats by catching mice or birds, wolves by devouring sheep? If such be the order of Nature as devised and ordained by its author, it follows of course—even as Mr. Gunning,* (who hates a gun and never *goes* a-gunning), says he fears—that the Devil lives by inveigling greedy men. But mankind are not wolfish? oh, no! The good shepherd careth for the *sheep*, the wolf only for mutton. How much less iniquitous than wolves are mankind generally in dealing with brutes? How long since victors in human warfare made meat of their captives? What makes the difference between a man-eater and a pork-eater? A degenerate appetite. How much better than spiders are the human epicures of to-day who foster and sometimes pet confiding brutes, and then slaughter them for food?

Think — but who does think? — how it ought to smirch the religious purport of a human thanksgiving, or the generous aspect of Christmas, to ponder the predatory carnage and havoc of sub-human consciousness which either festival enjoins. Think of the butcher's barbarous vocation and who *else* is responsible for the wrongs he perpetrates on the hapless victims of human truckling to carnivorous appetites. These are traductive from man's brute ancestry, for which fact nobody is accountable. But all personal attributes concur in impugning their indulgence, which alone prolongs their existence and tends only to retard the development of human nature. It is only by evading reflection and ignoring the natural rights of all incumbents of sentiency that clever people are enabled to feast without repugnance or remorse on cutlets of their slaughtered relatives. By luxuriating on beef and mutton, poultry and pork, we affiliate the animal bias with which these meats are magnetized, and so nurture the lower propensities of mentality at the expense of the higher as to dwarf self-hood and postpone the prospective era of human maturity. "Man's inhumanity to man" has long been regarded as the most enormous and deplorable of all sublunary evils; and this is connate with human maltreatment of brutes. The one is as veteran as the other; but neither is inveterate. They are to be cognized as the twin-progeny of human depravity, which, as aforesaid, is the brat of ignorance and incompetent free-agency. But intelligence is the natural fruit of experience by means of which all evil will in time be supplanted; not, however, till mankind have learned *the Art of Living*, one of whose primordial institutes must be a vegetarian diet.

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* Prof. W. D Gunning, a well-known writer for *The Index*, and for *The Open Court*. He died at Greely, Col., March 8, 1888.

There remains a single unknown quantity which it seems impossible at present to eliminate from the problem of evil; and that is, the reality of certain apparent products of natural causation in behalf of sentient malignity appurtenant to animal endowments preversely instigated, such as the virulent stings and fangs of irrascible and implacable serpents. (For is not the intimation of design as obtrusive here as elsewhere?) But these, surely, are less horrid than such blights of cerebral development as constitute a born knave of any human type. Yet science accounts for the latter as depending on the esoteric principle of embryology whence a *nævus* ensues. Why should maternal longings be more effective in one grade of mentality than in another? and who has measured the scope of animal magnetism — the occult power whreby mentality is propagated from parent to child? Our inability to solve the problem of evil as to the source of *this one* of its many features only, does not warrant the conclusion that it is insolvable. Our failure may be due to sheer lack of scientific information. Much less does it justify the inference, as certain writers have imagined, that God has ordained the existence of evil in any of its diverse forms. That he has not — that evil is not enacted nor purposely tolerated by the Author of Nature is implied by its impulsive resistence by all mankind, inasmuch as he inspires our innate resentment. Man's disgust of evil tends to its temporary restriction and ultimate extinction. In the coming Age of Virtue the universal prayer for deliverance from evil will be answered to the gratitude of all incumbents of human maturity, not a soul of whom can then be happy without *knowing* — what all the foregoing reflections conspire to certify —

X. *That Personality is Immortal.*

Being assured that the parent of mankind and author of all finite existence is all-loving; that he is the giver of good and good only, within the restrictive limits of possibility; that he is amenable to the same law of self-conduct as are all finite persons; that he is bound to do right by inherent love of Justice, no less than as the pivot of his own happiness; we are forefended from any question of his purpose or ability to promote the ultimate welfare of all dependents on his bounty. Yet, though the most of these at any given time are tolerably well-to-do, everybody knows that a considerable portion of mankind, as well as of other species, are at the same time victims of evil through poverty, disease, fatuity, imposture or oppression. Human sympathy goes far to assuage these forms of suffering, but is inadequate to their elimination from human experience, though in time it will forestall them. But hitherto the sphere of humanity has been a theater of iniquity; and no tribunal of exact justice has as yet obtained in any civil state. This is because the agent of natural causation rules the world to some extent vicariously, and humanity is the virtual vicegerent of divine beneficence. What though in the upshot of human development man shall be competent and faithful as the steward of divine munificence; what though the finale of human experience be glorious, and the last generation of mankind be ever so grateful for its heritage of magnanimity and scope of felicitous resources? Can the legatees of all past generations be satisfied to monopolize the revenues of their ancestors who have labored and suffered in their behalf without a recompense? Not if the last generation shall be worthy of its emolument. Not if man at the epoch of human maturity shall be at all sympathetic, or cherish a benign regard for his ancestry such as he now cherishes. Not unless the best-developed of mankind shall care nothing for the principle of equity, and be utterly selfish in aspiration; nor, indeed, if adult humanity shall have any foresight of its own mortal destiny; for why should the last generation be immortal if its predecessors are not?

To follow the lead of these reflections is to be convinced that personality is immortal: for it is patent to universal observation that many wrongs are not avenged in this world, that many worthy acts are not duly requited, and that every person is occasionally conscious of vain and faultless endeavor to realize a natural want; while for these failings of Nature no amends are possible unless there be a future state of retribution, which to be effective must be endless. Thus it appears that the immortality of all mankind is as certain as the postulate that God cares for justice.

The same induction is also germane to the concept of utility. For physical evolution culminates in humanity as the coëtaneous use of mundane existence. But to what purpose is humanity evolved if it do not survive the era of its maturity? If personality is worth generating, why should it not be worth sustaining? What a waste of divine energy, as well as of inspiration, is implied by the operations of Nature whereby life and sense have been engendered and nurtured from protozoa to incumbents of human attributes, if the latter be not perpetuated. Think — with what throes of antique mentality humanity was born — and to no lasting avail? All sublunary evil is incidental to the birth and education of finite personality. We have seen above that the author of Nature tolerates temporal evil only for sake of the ulterior good, otherwise not attainable, for which at length all its emancipated patients will be grateful. But can this be, if the ultimate beneficiaries of personal maturity are ever to be deprived of that for which they are grateful? And what motive can the agent of natural causation have to evolve personalities only to perish? Such an employment would be as incongruous with divine attributes as devotion to blowing soap-bubbles would be with those of a philosopher.

Why cannot mankind be happy without assurance of immortality? Because of every soul's inherent love of life. This is what makes sentient beings susceptible of enjoyment. If we did not love life we should not care to live — it would be burdensome. We are grateful only for what we prize; and it is only what we want that gives us pleasure — only what we are grateful for that ministers to our gratification. But in proportion as we are grateful for anything we are unwilling to forego or part with it. So our love of life makes us dread death. So we cherish hope for life after physical death, and are glad to recognize the presentiment of our immortal destiny as a divine pledge of its certainty. And what does reason say to this innate presumption? It bids us note that our love of life and hope to live forever are involuntary. We cannot suppress either; therefore both are instinctive. God inspires and makes us sensible of these natural wants because they are also *his* wants. For why should he create what he does not *want*, even in his own behalf? Do we lack older evidence than is here suggested that God's motives to action are largely altruistic, that he delights in the welfare of all sentient beings, yet with a hinge upon self-love, so that even for God's sake as well as for its own sake, every soul is immortal?

The argument for personal immortality presented above admits of the following summary. All mankind are immortal —

1. Because the Author of Nature is just, and justice does not obtain in this world.
2. Because the physical world without its sentient inhabitants would be utterly useless, and mundane existence without its complement would be wrongful to mankind; and God is neither an idler nor a malefactor.
3. Because man wants to live forever to realize the visions of Hope, which, as a product of divine inspiration, is the prophet of human destiny.
4. Because God creates only what is subservient to his own eternal wants; and mankind are embryonic implements of divine felicity. In other words, every soul is immortal because God himself wants it to be *for very love's sake;* and this makes his happiness inseparable from that of all sentient beings, insomuch that the Infinite Mind, as the parent of mentality, must be pained to know that any soul were wronged.

Here ends my argument for personal immortality, to which I am minded to subjoin some reflections concerning the sense in which all souls are properly said to be immortal. It is edifying to conceive furthermore that no form or grade of mentality can live forever *in statu quo*, but —

XI. *That every soul is immortal only through progression.*

It is estimated that about half the world of mankind die in infancy and childhood; and transient livers are as much entitled (at least by heritage) to live hereafter as are adults. Maternal love will vouch for this, and never yield its claim. But infants and children are not immortal *as* such, but are subject to the same laws of personal development in the world to come as in this world. So, inasmuch as all mankind are but partially educated in the sphere of physical life, they are not immortal as to their respective grades of character as formed by sublunary experience, but are destined to progress in intelligence, ability, and moral attributes toward personal perfection as exemplified by the Parent of Mentality.

As to the finale of personal development in the world of everlasting life, it is hardly advisable to speculate. I like the saying of Jesus regarding human destiny more for its purport of sagacity than for its literal perspicuity, to wit: "No man knoweth who the Son is, but the Father; nor who the Father is, but the Son, and he to whom the Son shall reveal him." This is not the language in which Jesus spoke to the Jews of his day, and doubtless his apothem is marred by its double translation from his vernacular to Greek and from Greek to English. It is probable that the sage of Nazareth entertained a thought nearly equivalent to this: None but the Parent of Mentality can apprehend the scope of magnanimity which shall crown the everlasting development of humanity's offspring, to whom the attributes of humanity's Parent are yet to be revealed in proportion as finite personality shall verge to a semblance of the Infinite Mind. That refutes the conceit of Paul that humanity has brought nothing into this world and can carry nothing out of it; though every soul must leave behind all that can ever perish. Who then will be rich? May not the predicament admit of conserving all that any should prize? Certainly, and more than that. Who then can be poor? Say first, who that has put off carnal life and been robed in the habiliments of spiritual purity will not find in memory's inventory chattels which none can wish to retain. Rich indeed the flesh-freed soul who may not be constrained to grief or shame even for secret sins which can no more be veiled.

But, in time, progression will virtually eliminate that, as it will also the converted felon's remorse. Progression will palliate the absolute sense of guilt, though this will never drown in Lethe's fabled stream. Oblivion of past self-conduct would be the death of selfhood. Remembered experience, active and passive, must be the core of conscious identity, and so the base of personal immortality. "The book of life" is a continuous record of self-conduct, as well as of incidental experience, made from first to last with indelible ink. It contains not a word relevant to vicarious atonement for wrong, divine forgiveness of sins, or the virtue of faith in imputed righteousness, to save a soul from evil. "Responsibility" and "Retribution" are the alternate running titles of each successive twain of its opposite pages.

Progression is born of endeavor, which, though voluntary, may be prompted either by adverse experience or by aspiration. In the latter case it purports a nobler personal character than in the former. But aspiration and its negative are both hereditary. The well-born is only more fortunate than the ill-born, not more praise-worthy for *that.* So, when the rationale of natal personality is considered, there seems to be neither merit nor demerit without a moral exception.

The born-knave who lives to make a career of sublunary experience is less fortunate than an infant of few days on Earth, or than a born-idiot whose experience in this world is abortive; since an untaught *parvenu* in the spirit-world has nothing to unlearn and no habitudes to reform, whereas the born-knave, by misbehaviour in the mundane sphere, has degenerated personally so as to commence life in the superhuman sphere on a lower plane of development, morally, than does a translated babe or idiot.

Experience is our only educator, here and there, and there is no reason for thinking *that* will be less efficient in the future world than in the present. The supra-mundane state of sentient existence, as a stage of evolution or sphere of experience consecutive to the mundane state, must be supplemental in utility. Our education initiates here to be completed hereafter. The inference is logical from the certainty that no person is fully educated in this life. If partially-educated adults are further educated in the world to come, so may babes and idiots be primarily educated there. So may still-born babes be born to consciousness primarily in the spirit world. But this cannot be unless the human fetus is indued with an immortal self-hood discrete from its physical form. Of course it is. Why then may not inferior grades of mentality also be indued with an undying soul, which is inherently bound to grow even to attainment of human attributes?

Prima facie, there seems to be one more reason in favor of human than of brute immortality. Mankind have a notion of a posthumous state of existence, and hope to realize it; whereas brutes are presumed to have no apprehension even of death, and much less of living in another sphere of consciousness. But due reflection will convince the rational thinker that the attempted discrimination concerns what is more apparent than real. Brutes love life in the same sense as do mankind; and though they have no notion of death nor of what may follow it, their instinctive struggle for continuous life here is analogous to our hope of a future state, which is due more to our assurance that we *must* die and leave *this* world than to an optional predilection for life in the world to come. Moreover, many a human agnostic professes to know nothing about another world, only that *this* "our little life is rounded by a sleep." And when a poet or philosopher in view of approaching death "draws the drapery of his couch about him and lies down to pleasant dreams," does one seem to act more intelligently than the caterpillar when it seeks a place of security and wraps itself in the only garment that befits its transformation to a butterfly?

May we not conclude, since there is but one constitution of mentality that all its forms are immortal, the distinctive epithets *brute* and *human* being merely more or less representative of the one paragon of personality—*the Infinite Mind*? Experience is the *alma mater* of every finite soul, and progression is the one savior of all sentient beings, every individual of every species of which is a growing child of God.

While it is possible to ascertain the reality of a spiritual sphere of existence to which every soul born to consciousness in the physical world is bound to emigrate, it is not possible to idealize the elements and issues of life therein beyond what is suggested by sublunary experience. But, inasmuch as the retrospective eras of humanity are consecutively progressive, and as each stage of personal development is superior to its precedent; as childhood is better than infancy, youth is an eligible supplement to childhood, and manhood transcends youth by complementive endowments; it is reasonable to conclude that life in the celestial world will be more satisfying than life on Earth—that the zest of consciousness will never pall—that the fruits of immortality will prove more and more delectable forever.

CHAPTER XVI.

SUMMARY AND CONCLUSION.

This book will end with a commentary * on its recapitulated subject-matter. The elements of this, as designated in the foregoing pages, are distinctively scientific and philosophic; those pertaining to the Pericosmic Theory and these to its Sequel.

The Pericosmic Theory purports a genus of original discoveries in physics, cognizable as novel constituents of Science Proper. The briefest analytical statement of this theory is given at the beginning of chapter XIII. That statement, however, does not embrace all the inductive truths imported by the gist of the theory, the most appreciable avails of which are made apprehensible by sequential considerations.

The germ of the Pericosmic Theory is the rationale of gravity, the only clew to which ever apprehended as probable by non-speculative scientists, is that suggested by the dynamic properties of the luminiferous Ether. But when inquest is made in this direction, it is readily ascertained that the Ether's pressure as

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* The least-promising yet note-worthy components of the proposed commentary though proffered with inappreciable complacency, are the following specifications of typographic failure, which were discovered too late for opportune adjustment.

1. At the top of page 110, two sentences are merged in one, and the meaning of both is perverted to falsity, by omitting ten words here denoted by the italic portion of the following unmutilated copy thereof:

"The line *A E* bisects the Earth's orbit equably, and so does indicated by the velocity of light is not *alone* sufficient to cause the gravitation of Matter to the issues of cosmic evolution; but that, to this purpose, the volume of Ether must rotate. Well, then I postulate its rotation, and lo! an un-heard-of dynamic principle is thereby brought to light, to wit: *the vehicular motion of Matter*—gravity's compeer and co-agent in the perpetual process of cosmic evolution. These two dynamic principles underlie and instigate all the so-called operations of Nature. The Pericosmic Ether, as the vehicle of Matter, comprises all physical phenomena, and colligates all the special sciences. Thus the rationale of gravity proves to be the harbinger of Cosmology Proper, complementing as it does the Nebular Hypothesis, by tracing the history of nebulæ back to the native process of their formation.

The vehicular motion of Matter is a brand-new discovery, no less essential to cosmology than is the soli-terrestrial cause of day and night to practical astronomy. The two discoveries are in many respects analogous. As the one depends on the Earth's axial rotation, so the other depends on the rotation of the Universe. Is it possible that the latter announcement will be as tardily assented to by mankind as was the former? It took more than two thousand years to coax the ears of common-sense to that; but then, Pythagoras did not write his thought, and if he had made it legible as well as audible, few in his day could have read it. It is likely that human nature,

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the line *C G*; and the two by coincidence divide it into four equal parts. *But the same is otherwise divided into four unequal parts* by the consentaneous precincts represented by the lines *o s* and *y z*."

2. The sentence beginning in the middle of page 129 is mutilated to a three-fold absurdity, by the omission of seven words in its initial clause and eight in its terminal clause, as indicated by the two italic portions of its original as here reproduced:

"Beyond a further question, however, it is otherwise ascerin virtue of its multiplied facilities, is more docile now. However this may be, I am sure that the rotation of the pericosm is as well-attested mathematically as that of our planet. In fact, there are four specific functions of force in the physical world to each of which the vehicular motion of Matter with a curvilinear trend is indispensable as their common factor. These are :—

1. *The formation of nebulæ* by the spiral motion of Matter in effect of the Ether's compressure coincidently with the rotation of its volume.

2. *The genesis of nebular rotation* by the contemporaneous condensation of nebulous matter and its vehicular motion trending from spiral to rotary.

3. The rotation of planets as resulting from the diametric difference of their orbital motion together with that of their vehicular motion.

4. Last, but not least, *the virtual creation of centrifugal force by the rotation of the pericosm*, as the primordial coëfficient of centripetal or static force.

These four functions of motivity are duly expounded in the foregoing part of this essay, in accord with conventional science.

Just here it may seem pertinent to ask why one investigator has been more successful than many of his contemporaries of superior reputation; and in virtual reply to such a query I adduce the following testimony of a professional scientist of the class here adverted to.

"One only of the many hypotheses which have been advanced to explain the cause of gravitation

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tained that the Earth's solar gravity increases gradually from *aphelion to perihelion and decreases gradually from* perihelion to apohelion; while the velocity of the Earth's orbital motion (and consequently its centrifugal bent) is as gradually accelerated from its *minimum to its maximum and retarded from its* maximum to its minimum."

3. On page 172, six words are unprinted in an important

has succeeded in passing the first preliminary tests. Of course, the assumption of action at a distance may be made to account for anything; but it is impossible (as Newton long ago pointed out in his celebrated letters to Bentley) for any one who has in philosophical matters a competent faculty of thinking for a moment to admit the possibility of such action.

"Hence we have but two ways of accounting for gravitation: either it is due to differences of pressure in a substance continuously filling all space except where matter displaces it (?), or it is due to impacts, in some respects analogous to those of the particles of a gas which have been found to be capable of accounting for gaseous pressure. Now all attempts to connect it with the luminiferous ether, or the medium required to explain electric and magnetic distance action, have completely failed; so that we are apparently driven to the impact theory as the only tenable one."*

The bias of this citation is quite ambiguous. While it sets at naught the vulgar notion of material attraction, it avows an incipient confidence in the Ether's relevance only to be smothered by misconception of its real character. In this respect it represents two or more very obvious reasons for the failure of several notable scientists to discover the rationale of gravity, who have cherished an apprehension that

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astronomic statement, as italicised in the following clause thereof:

"Inclination of the plane of its *suborbit to the plane of its* solar orbit."

4. On page 14, line 16, the word *convenient* should qualify "means."

5. On page 90, the figure terminating the first term of the stated proportion should be 1 instead of 7.

6. On page 118, line 14 from below, the figure 5 is repeated

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* The Unseen Universe, page 101.

its physical agent may be identified with the medium of light. One of these is indicated by the clause designating the Ether as "a substance continuously filling all space," in which case its rotation would be impossible; for whatever rotates must have a centre, which is not imputable to infinite space; nor, without a center, would it be conceivable as an atom of concentric force, but only as a species of matter; and this is another reason for the alleged failure, since matter is non-continuous, as well as subject to gravity's physical agent, which must therefore be exterior to and unlike Matter. Still another hinderance to the proffered desideratum is denoted by the parenthetic interrogation point after the thought of ether's susceptibility to be displaced by the constituents of Matter, as if it were impossible; a dubitation which is nullified by conceiving that the pith of intra-ethereal atoms is itself ethereal. As material particles hold their own respectively against each other, so they may and do in relation to the ether, from which they differ only in magnitude.

The rationale of gravity is pregnant with scientific implications. As set forth in the purview of the Pericosmic Theory, it makes way for numerous deductions of which several are worthy of re-mention, either for their respective fitness to dispel mystery,

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in a way to represent the Earth's daily orbital motion, during Autumn and Winter, fourteen million miles greater than it is.

7. On page 203, line 12 from above, the word *varying* is omitted before "vehicular motion."

8. On page 207, line 12 from above, read 88 instead of "83."

9. On page 210, line 15 from below, read 1696922 instead of "1692922."

10. On page 221, line 16, "universally" should have read *inversely*.

11. On page 222, Question 8, before "astronomers" read *some*.

12. On page 283, line 6 from below, instead of "comprised" read *compromised*.

or for their aptness to refute collectively as many vagaries of nominal science.

I. *As to the purlieus of gravitation.*

If the hypothesis relevant to the concept of nebular formation, stated at the opening of the fifth chapter of this essay, be taken for granted (and besides having no rival it is consistent with the otherwise-ascertained factors of nebular rotation), it will justify the inference that Newton's conception of the law of gravitation was, as to one point of its statement, utterly false. Though gravity is a universal truth, and though correlated particles gravitate toward each other with a force inversely proportional to the square of the distance between them, it does not follow that therefore each particle of matter in the Universe gravitates toward every other. The law of gravitation as discovered by Newton has been verified by observation within, but not beyond, the confines of our Solar System; and so by induction it is predicable of every other Solar System *per se*, but not *therefore* of all collectively *inter se*. Contra-wise, the fact that the members of every visible constellation are permanently "fixed" in relation to each other, demonstrates their commutual non-gravitation. And furthermore, this induction is enforced by the theory of evolution: for, if nebular formation is to be regarded as the primordial part of the process of cosmic evolution, it follows that the two pericosmic forces which co-operated to the genesis of nebular rotation must have co-oporated previously to the formation of nebulæ, since they are coëval with mundane existence. According to the Pericosmic Theory, these two forces co-operated in such wise as to generate throughout the pericosm sporadic *nuclëi* of spiral motion resulting in the formation of as many rotating nebulæ; and the verisimilitude of this conception, whereby the primeval reservoir of diffuse matter was aboriginally divided and multitudinously aggregated, implies the virtual division of the pericosm itself into innumerable spheres of isolated gravity, *alias* concentric trends of the Ether's pressure, the centers of which became so many disparate goals of Matter's perpetual gravitation.

II. *As to the rationale of momentum.*

Why does a body once set in motion continue to move until obstructed by some counter-force? "Because it has no power to stop moving," says antique speculation in the name of science.* If that be true, then why is a man's attempt to lift a ton followed by no momentum? Certainly, not because no *force* is imimparted to the weight; for, if the latter be in one of a pair of scales, everybody knows that it will be balanced by less than a ton ; yet there is no momentum of tentative lifting. Does not this fact refute the assumption that force imparted to a body is inherently persistent? Hear now the answer suggested by the Pericosmic Theory: When a body is put in motion it continues to move because the ether which is displaced before the moving body collapses behind it with a force commensurate with its motific impetus; but when the impetus is insufficient to beget motion, as it is in case of tentative lifting, the ether is undisturbed, there is no incentive to its collapse and therefore no momentum.

III. *As to the make of Matter.*

"From a physical point of view, matter is anything that can affect the senses, or that can exert, or be acted on by, force. The existence of matter, in the

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*"When a body is once set in motion it will continue to move forever, unless something stops it . . . . . The heavenly bodies are actually in this condition: they continue to move, not because any new forces are applied to them, but, having been once set in motion, they continue in motion because there is nothing to stop them."—*Denison Olmstead*, L L. D. of *Yale College*, 1885.

sense of substance, has been doubted by many philosophers, including some of the greatest experimenters. Indeed, as we know matter only by the forces it exerts, it is obvious that the supposition of geometric points, capable of exerting force (technically called *centers of force*), will as satisfactorally account for all observed phenomena as any other idea of the ultimate nature of matter. Here, however, we are dealing with a question confessedly beyond the reach of experiment, and belonging to the domain with which metaphysics professes to deal. The old idea of the transmutation of metals implicitly contains the assumption that all kinds of matter are ultimately one. Far from being a startling assumption, this is the simplest and most easily-conceived notion we can entertain on the subject."—*Chambers's Encyclopedia.*

"In ancient philosophy, two theories of the nature of matter were recognized, and these have continued to form subjects of argument among speculative men since the year 510 B. C. to the present time. The one theory is that matter is infinitely divisible, the other rcognizes the finite divisibility of matter, and considers that all matter is more or less compactly built up of myriads of atoms aggregated together, and having spaces or pores between the several atoms or particles. If it were possible to subject such matter to the scrutiny of a sufficiently powerful magnifying-glass, or microscope, ... an appearance would be presented similar to that which the painter chooses to depict on the canvas when he is representing a snow-storm, ... or that which would be observed if, during a hail-storm, some great power were to cry, "Halt!" and that instant every minute hail-stone was arrested in the spot it had reached."—*Ibid.*

Thus conventional science, while it accepts in general terms the atomic theory as to the occult constitution of overt matter, leaves the description of atoms to the forte of fancy. But the Pericosmic Theory supplies a plausible explication of both their pith and structure. The reader will please compare the two testimonials of an encyclopedist here presented with what is said on the same topic in chapter IV.

IV. *As to the mode and gist of chemical action.*

Another extract from the same compilation of scientistic as well as scientific literature from which the two preceding paragraphs are quoted, will show how speculation has rivaled intelligence hitherto in attempting to discuss the principle of this last-written topic.

"According to the molecular theory, matter consists of small particles, each of which is in motion, and this motion is the more rapid the hotter the substance is. These small particles or molecules cannot be broken up without changing the character and properties of the substance. They are not, however, *atoms*. In the case of compounds, as the molecules of any *one* substance are all similar to one another, each molecule must contain all the components: and in many elementary substances it can be proved, assuming the truth of the molecular theory, that each molecule consists of several similar atoms. A molecule, then, is either a single atom, as in *some* elementary substances, or a group of atoms which remain together during those movements which depend on the temperature of a substance. Now, the velocity of these motions increases as the temperature is raised; when, therefore, the temperature is raised so high, and the velocity of the molecules becomes so great that the collision of the molecules with one another is sufficiently violent to break them up and separate their constituent atoms, the substance is decomposed, the atoms re-arranging themselves into new groups (or molecules) capable of remaining unbroken under the new conditions. This explains the decomposition of compounds by the action of heat."

But it does not reveal the cause of heat *as an agent*, nor suggest a reason for the re-arrangement of atoms to the formation of new molecules, except, as the writer goes on to say—

"If two substances are mixed together, it may happen that some atoms in the one set of molecules are so attracted by some atoms in the other set, that, when the molecule of the one set meets one of the other set in a vibrating or loosened condition, an exchange of atoms may take place between them, or each may lose a part of its atoms, these going to form a new molecule."

Now, on this point, instead of *guessing what may happen*, the Pericosmic Theory discovers *what must occur*, in the said predicament of submaterial and intra-ethereal atoms, as well as *why* and *how* chemical action is in all cases effected. This assertion is justified by the answer to question 9 in chapter XIII.

V. *As to the concept of force.*

"Till we know what matter is, if *there be* matter, in the ordinary sense of the word, at all," declares the author of the article "Force—Energy," in the compilation of facts and theories already made tributary to the elucidation of two topics, "we cannot hope to have any idea of the absolute nature of force. Any speculations on the subject could only lead us into a train of hypotheses entirely metaphysical, since utterly beyond the present powers of experimental science. If we content ourselves with a definition of force based on experience, such a definition will say nothing of its nature, but will confine itself to the effects which are said to be due to force, and in the present state of our knowledge it is almost preposterous to aim at more. . . . . We must not hastily conclude that there is such a *thing* as force, though we are in the constant habit of speaking about it."

Thus vague and dubious has been the conventional notion of force hitherto, even among practical scientists. Nevertheless, between the former and latter of these two conjoined citations, the same writer propounds the scientific definition of force as "*any cause which produces, or tends to produce, a change in a body's state of rest or motion;*" and then proceeds to say that "the amount or magnitude of a force may be measured in one of two ways: 1. By the pressure it can produce or the weight it can support; 2. By the amount of motion it can produce in a given time. These are called respectively the static and dynamic measures of force. Hence," he subjoins by way of inference from Newton's third law of motion, "momentum is the true dynamical measure of force."

These several propositions are tenable beyond disputation. But why, it is proper to ask, are there two ways of measuring force, unless there be two kinds of force to be measured, as denoted by the given adjectives? How differs the *static measure* of force from a measure of *static force?* According to the Pericosmic Theory, the latter is the more expressive phrase. Force, in all of its manifestations, is indeed dynamic, because of its essential potency and casual tendency to beget motion by re-action of its *nidus* when acted on. Yet there are two phases of static force, namely: That which appears conceptively as the pith of atoms — concentric force, — and that which aggregates atoms; *pressure* being also the common name for both these phases of static force, which are distinguished as gravity and gravitation. Besides static force but one other species is conceivable, and that is motoric force, the only mode of which is the inherent rotation of atoms. But one submaterial atom has no power to move another, or to act on the pericosmic atom except by way of re-action; and the power of this to move the sub-material atoms depends on the sub-relation of Matter to the Ether.

Force is incorporeal and therefore formless, and no concept of it is possible apart from some vehicle, which must be either material or ethereal. Both these modes of corporeity are motile; but motivity pertains only to the Ether, the motility of which depends on its power to move Matter and be moved by matter's re-action on its motor: the power to re-act being due to the elasticity of a body, and this property being common to both modes of corporeity. In this way, it is conceivable that force is not a corporeal verity, but an endowment of atoms having primarily two bents of instrumentality, or guises of occult causation, distinguishable as *concentric pressure* and *rotary motion.* By correlation as container and contained, the Ether only is indued with perpetual, and Matter only with casual, motivity; and the former is not transferable. Though the translation and even transmutation of pericosmic motivity are affirmed in chapter VII. of this essay, the predicates are to be understood as virtual and not absolute. The nominal transition of force from particle to particle is always recognized as some form of momentum, the rationale of which as given above demonstrates that the pericosm is the exclusive *nidus* thereof, only by means of a different function from that of aboriginal motivity.

VI. *As to the origin and conservation of force, and the correlation of its transitional apparitions.*

"When the nebulous chaos first separated itself from other fixed-star masses," so writes Helmholtz as translated by Tyndall, "it must not only have contained all kinds of matter which was to constitute the future planetary system, but also, in accordance with our new law, the whole store of force which at one time must unfold therein its wealth of actions. . . This force, which on the Earth exerts itself as gravity, acts in the heavenly spaces as gravitation. . . . . The chemical forces must have been also present, ready to act; but as these forces can only come into operation by the most intimate contact of different masses, condensation must have taken place before the play of chemical forces began. Whether a still further supply of force in the shape of heat was present at the commencement we do not know."

Now, we have seen in dealing with the second topic of this chapter that there are but two species of force in Nature, though either species appears under diverse phases. It is obvious that all the static force now imbodied in the physical world was present in the primeval state of Matter. Since the statement assumes that the quantum of matter in the Universe is constant for all time, and intimates that Matter is the only-existing corporeal substance, Helmholtz must have meant to say that "the nebulous chaos" out of which the extant Cosmos has been evolved was pregnant with the *tout ensemble of motoric force* subsequently and prospectively manifest as the virtual agent of mundane evolution; and *that*, though occult, under some one of its protean phases, of which that idealized as *potential* is most probable. Of this nominal phase of *vis mortuüm* Dr. Mayer has spoken thus:

"A cause which brings about the raising of a weight is a force; its effect (the raised weight) is, accordingly, equally a force; or, expressing this relation in a more general form, *separation in space of ponderable objects is a force;* since this force causes the fall of bodies, we call it "falling force."

In this sense, and not conceivably in any other, Matter in its primorially-diffused state may be said to have been the store-house of "falling force;" that is to say, according to the assumption that gravity is a property of Matter: but this assumption is repudiated by every non-speculative scientist. Here is a specimen of its misleading tendency:

"Visible kinetic energy, such as that of a cannon-ball shot upward, is transformed as it rises into visible potential energy. As the ball descends its energy is re-transformed from the potential into the kinetic variety until, when it is about to strike the earth, it has, or rather would have if there were no atmosphere, as much kinetic energy as it had when it was first shot upward.* . . . . . We have just now spoken about a cannon-ball fired into the air against the force of gravity. Such a ball, as it mounts, will each moment lose part of its velocity, until it finally comes to a stand-still, after which it will begin to descend. When it is just turning it is perfectly harmless, and, if we were standing on the top of a cliff to which it had just reached, we might without danger catch it in our arms and lodge it on the cliff. Its energy has apparently disappeared. Let us, however, see whether this is really true or not. It was fired up at us, let us say, by a foe at the bottom of the cliff, and the thought occurs to us to drop it down upon him again, which we do with great success, for he is smashed to pieces by the ball. In truth, dynamics informs us that such a ball will again strike the ground with a velocity, and therefore with an energy, precisely equal to that with which it was originally projected upward. [WHY ?] Now, when at the top of the cliff, if it had not the energy due to actual motion,† it had nevertheless some sort of energy due to its elevated position, for it had obviously the power to do work.* *We thus recognize two forms of energy which change into one another, the one due to actual motion, and the other to position; the former of these is generally called kinetic, and the latter potential energy.*" — [*From the Unseen Universe.*]

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* **Is it scientific to refrain from asking *Why?***

† **Is energy due to motion, or motion due to energy?**

Two points of assertion in the last-quoted sentence are supposititions, notwithstanding its typical emphasis. Motion on a horizontal plane entails momentum, which is a form of actual energy, in this case equable; but the momentum entailed by motion downward is incremental, terminating in re-action and atomic commotion; whereas that of motion upward is decremental, terminating in rest, due, not to loss of energy as to its vehicle (since passive motion is devoid of energy), but to the exhaustion of an impetus, some variety of which is the sole cause of motion, which is always adventitious to the thing moved.

Talk about an energy of position amounts to nothing intelligible as to the cause of dynamic phenomena. What we want to understand is, how "falling force" obtains; why bodies when lifted from the Earth's surface and let go, fall back again; and why their fall is accelerated. Here are three questions which have been unanswered hitherto, but are readily answered by the Pericosmic Theory as being identified with the rationale of gravity, momentum, inertia, chemical action and every physical mode of motion. A ball shot upward is not a vehicle of the energy by which it is projected, but only of passive motion, the chemical impetus to which is vehicled and propagated in the name of momentum, and this form of energy pertains to the ether, as explained above. So planetary motion, as well as the rotation of its nebular antecedent, is the sheer effect of pericosmic energy. In fact, each of the two dynamic attributes of the pericosm is a constant quantity in no wise and in no measure transferable.

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* Any more than a stone as heavy, lying on the top of the cliff to which it is native ?

The proposition that "*separation in space of ponderable objects is a force*," is mystical and of no avail to science until we know the reason for its virtual truth. It is true only in the sense that the separation of two connected particles in the line of gravity requires a measure of force just equal to that with which they seem to be indued by gravitating to reconnection. But this is not a scientific truth, but a fact of common observation from time immemorial. The mystery of its cause is as great now as before Newton discovered the *law* of gravitation; and this mystery is penetrable only by conceiving *why* Matter gravitates, and *how it is made to gravitate.* When the cause of gravity is imputed to *the pressure of the Ether*, the reason for the fact which Mayer's statement rather mystifies, becomes obvious.

VII. *As to the absolute cause of force.*

Conventional science has as yet designated but one pristine mode of physical force the domain of which is cosmical, or universal, namely, that of gravity and gravitation, regarded as two phases of a single dynamic principle. But the Pericosmic Theory represents two distinct modes thereof, or else two dynamic principles of independent, equipollent and antithetic sway, the domain of which is biune and concordant. The co-agency of these two modes of motivity is due to their being vested in one and the same *nidus*. Is not the occlusion of Matter in the Ether as the base of their interaction, together with the Ether's pressure as the mode of Matter's gravity and gravitation, and the rotation of Matter's vehicle as the mode of both its centrifugation and vehicular motion, a more intelligible hypothesis than any heretofore proposed to account for *all* the physical operations of Nature? And now, since it is found to be consistent with all natural phenomena, who will undertake to refute the Pericosmic Theory? Unless some acute thinker shall do this, practical scientists who are wont to keep their eyes and ears open will have to enlarge the sphere of their vocation by at least one item of legitimate investigation; and that is my last written topic.

"Can we," asks Dr. Grove, "suggest a proportion definitely conceivable by the mind, of force without antecedent force? I cannot, without calling for the interposition of created power, any more than I can conceive the sudden appearance of a mass of matter come from nowhere and formed from nothing. . . . To think on Nature is to theorize; and difficult it is not to be led on by the continuities of natural phenomena to theories which appear forced and unintelligible to those who have not pursued the same path of thought: which, moreover, if allowed to gain an undue influence, seduce us from that truth which is the sole object of pursuit. Where to draw the line — where to say thus far we may go, and no farther, in any particular class of analogies or relations which Nature presents to us; how far to follow the progressive indications of thought, and where to resist its allurements — is a question of degree which must depend upon the judgment of each individual or of each class of thinkers; yet it is consolatory that thought is seldom expended in vain. * * * It is a great assistance in such investigations to be intimately convinced that no physical phenomena can stand alone: each is inevitably connected with anterior changes, and as inevitably productive of consequential changes, each with the other, and all with time and space; and, either in tracing back these antecedents or following up their consequents, many new phonomena will be discovered, and many existing phenomena, hitherto believed distinct, will be connected and explained. Explanation is, indeed, only relation to something more familiar, not more known — *i, e.* known to causative or creative agencies. In all phenomena the more closely they are investigated the more are we convinced that, humanly speaking, neither matter nor force can be created or annihilated, and that an essential cause is unattainable. Causation is the will, Creation the act, of God."

Is the cue of this quotation scientific, philosophic, or ecclesiastic? Is it to be fathomed as a verdict of Reason, or accepted implicitly as a maxim of Faith? This question, or one of like significance, has never been regarded as pertinent to the aims of conventional science, though here and there a representative scientist has treated its conceptive equivalent agnostically, as exemplified by Mr. Herbert Spencer in the brief extract from his *First Principles* which follows:

"All reasoned-out conclusions whatever must rest on some postulate. As before shown, we cannot go on merging derivative truths in these wider and wider truths from which they are derived, without reaching at last a widest truth which can be merged in no other. And whoever contemplates the relation in which it stands to the truths of science in general, will see that this truth, transcending demonstration, is the Persistence of Force. . . . . . This, being the basis of experience, must be the basis of any scientific organization of experience. To this an ultimate analysis brings us down; and on this a rational synthesis must be built up."

Thus, according to the head-light of physical and mental science, the existence and persistence of Force is the widest truth of rational conception. Faraday's thought on the same subject differs from Spencer's, inasmuch as percept differs from concept. Faraday called the persistence of force "the highest law in physical science which our faculties permit us to *perceive*." Spencer says, as I interpret his language, it is "*the widest truth*" that we are capable of conceiving. His diction must have been accepted *cum grano salis* by the late Prof. Youmans, who, in his introduction to a compilation of essays on "*the Correlation and Conservation of Forces*," cited both the statements here recited, adding as his own thought, as if consonant with Spencer's views of "the sole truth which transcends experience by underlying it," a series of relevant reflections, concluding with this sentiment of admiration: "How far transcending all stretch of thought that Unknown and Infinite Cause of all to which the human spirit turns evermore in solemn and mysterious worship!" But this apothem of Reverence does not touch the question proposed above. Dr. Mayer has also said as flippantly, though less seriously, "The first cause of things is Deity — a Being ever inscrutable by the intellect of man." Here again the pending question recurs: Is the reality so affirmed acceptable as an item of knowledge, or of simple belief? A metaphysician would answer to order, either way; but metaphysics are not germane to science.

Neither Mayer nor Youmans attempted to maintain his assertion of a cause of force anterior to force itself as a logical issue of science. Indeed, I am not aware that the sentiment has ever been uttered in the name of science; and the loudest metaphysician of the nineteenth century tells us that it cannot be demonstrated. On this topic, Spencer and Mansel hang together. Spencer says "the sincere man of science, content to follow wherever the evidence leads him, becomes profoundly convinced that the Universe is an insoluble problem. Though he may succeed in resolving all properties of objects into manifestations of force, he is not thereby enabled to realize what force is; but finds, on the contrary, that the more he thinks about it, the more he is baffled." This, propounded in the name of philosophy, tallies with what Mansel has said in the name of metaphysics, complemented thus: "In this impotence of reason, we are compelled to take refuge in faith, and to believe that an infinite being exists, though we know not how."

Just as if the reality of things depended on our ability to comprehend them.* What sentient being in the mundane sphere can comprehend the mode or pith of selfhood? The *ego* of consciousness is no less mysterious than the concept of creative power, or the divine paternity of finite personality. Yet, who merely believes in one's own existence?

Does not the persistence of force imply an anterior truth — its *cause?* To my mind it does; and this is a corollary from that: for, surely, force is not *self*-persistent, neither, as an attribute of Nature, can it be of necessity. Therefore it is *made to be* — a product of natural causation. In the realm of human experience causation never occurs apart from voluntary agency. Therefore causation in Nature is the *act* of its *Super*-natural Agent. The act of creative power is manifest in the physical world in the guise

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* The so-called "universal postulate (propounded in *Principles of Psychology*, Vol. II. page 406) is neither axiomatic nor demonstrable. It is not our inability to conceive its negation, which substantiates the reality of a conception, but our inability to doubt its reality, due to a positive conception that its negation cannot be realized.

Mr. Spencer says: "The legitimate *a priori* method sets out with propositions of which the negation is inconceivable." I would rather say, instead of *inconceivable*, *conceivably impossible*. For example: Some metaphysical thinkers tell us "there of Force, the absolute cause of which is apprehensible as *the Creator and Sustainer of mundane existence.* This truth is yet to be recognized as radically-pertinent to science proper, and not depreciated by considering that it is inferential and verifiable only by deduction from an element of consciousness. The intellective avails of experience are wholly inferential. Science consists largely of deductions. What do we know of the medium of light but by inference?—that "motion implies something moved." So a thing *made to be* implies a maker; and the maker of Force is the Parent of Mentality whose conventional name is God.

Creative power is limited to the domain of possibility. Omnipotence cannot do what cannot be done. God cannot create an infinite thing, nor a finite entity which shall be self-sustaining. Force being the basis of all existing things, none of which is self-existent, it follows by inference that the Cause of mundane existence is the Creator of Force. Moreover, since the guise of force is transitional, it must be perpetually created, and its creator must be ever-active as the super-natural agent of natural causation.

This truth is aptly elucidated by the scientific conception of light. As a mode of motion travers-

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may be a world wherein two and two do not make four." This proposition is not refuted by our inability to conceive its truth, but by our nominal ability to conceive its falsity—the *conviction* that it is absurd; and *why* absurd? Because it contradicts a necessary truth, and that which is necessary is unmodifiable by time or place. Therefore, in all worlds, two and two make four.

So "the notion of attraction" in physics is canceled not by its inconceivability, but by the positive conception of its impossibility. In like manner, that space is infinitely extended, is not ascertained by our inability to conceive its finitude hardly so much as oppugned by our inability to conceive its unbounded extent; which, nevertheless, is substantiated by the actual conception that *space cannot be limited.*

ing the pericosm in all directions, whither or to what goal, as Mr. John Fisk says, "none of us can surmise," though we are well-assured that it never returns to the source of its emanation, its perpetual creation is as obvious as the transientness of its stay at any point of illumination. And since concentric force is the pith of body, the existence of Matter and of the Ether is also prolonged only by continuity of the same effort on the part of their sustainer which was effective of their creation. So the rotation of the pericosm, as well as of the myriad atoms of hydrogen and oxygen, inasmuch as their self-rotation is impossible, connotes innumerable acts of creative power whereby the mundane guise of Force is perpetuated.

VIII. *As to the reality of finite intelligence.*

Are sentient beings functionaries of intellection? If so, how are the issues of their agency authenticated? Since all our faculties are more or less fallible, if Man is an automath, knowledge in the proper sense of the word would seem to be impossible. According to standard lexicography, *to know is to perceive with certainty;* to have a clear and certain perception of truth, fact, or anything that actually exists." How can "certain knowledge" be other than "absolute," that is "real and positive," involving no mistake? This is what is commonly understood by the unqualified word knowledge; and that "all knowledge is absolute" is one of the prolegomena to this book. Is that proposition original? Few of my readers will suspect its novelty, though Spencer told the world twenty-five years ago that "the sincere man of science, and he alone, truly *sees* that absolute knowledge is impossible." Let us see to which of these two opposite statements truth is allied.

It has been said that consciousness consists not merely in knowing, but in knowing that we know.

But this pleonasm rather flouts than explicates the subject. Is it not the immediate transformation of perception and conception, whereby things known are committed to memory, that the apparent knowing that we know consists? However this may be, the word "truism," according to scientific usage, applies exclusively to the prime elements of consciousness, which itself is complex and progressively comprehensive, always embracing some differential aggregation of perceptions. These are never simple, but always as units they are more or less complex in consequence of the simultaneous exercitation of the intellects of which it is a unanimous verdict. Nothing is known but objects of perception (extrospective or introspective), and whatever is known or perceived (the two words being equally expressive of certainty) is real and indubitable. In this sense, every component of knowledge is truismic, as self-evident as any truism proper. So long as a proposition is open to doubt, its truth is not perceived. When its truth is perceived, assent to it is inevitable. This is just what is meant by calling any proposition self-evident, as that two and two make four. This mathematical truth is not simple, neither is its perception a pristine element of consciousness. It is an excogitated truth, a product of intellective experience; yet it has the aspect and prestige of a simple truism.

So the reflections "I am" and "I think" are compositive issues of cognition. One cannot say "am" or "think" prior to the intellective birth of the subject "I;" and one cannot say "I," the symbol of self-hood, till one is conscious of self as discriminated from other entities, which must be thought of to make this possible. In a word, thinking must either precede, or be simultaneous with, the consciousness of thinking. Consciousness, then, cannot be the agent of that wherewith it is coincident. Yet the inception of consciousness must precede that of cognition, which intiates with the instinctive presentiment, or unconscious assumption, of selfhood as being endued with potential attributes and related to environing realities. This assumption involves several formulative truisms which are aboriginally latent and susceptible of suscitation only by experience. Pristine truisms are thus native to the latent elements of *natural faith*, that is the unconscious substratum of knowledge, the superstructure of consciousness consisting of excogitated truisms. Knowledge itself is perception of truth; and the test of truthful perception is *conviction* — an involuntary and indubitable sense of truth. This is consciously apprehended as *suscipient* — not self-wrought, but as an arbitrary compulsion to assent. While the intellective antecedents to conviction are commonly active and voluntary, the experience of conviction itself is utterly passive.

Now, perception is of two aspects, phenomenal and rational; and that species of conviction which ratifies phenomenal perception is no more positive and persistent than that which authenticates a reasoning process. In fact, that which enforces an inference or consummates a judgment is itself a perception, — the perception that the minor premise is germane to the major. Besides, every act of perception is reasoning in disguise, and terminates in a masked inference. So conviction in all its attitudes tallies with some pristine truism, showing that the acme of intelligence, the ultimate test of knowledge, is the suscitation of *natural faith.* Does this discovery tend to invalidate knowledge, or to validate truisms, the elements of natural faith? It must do one or the other: either this or that alternative is inevitable. Of logical necessity, either the substratum of consciousness is equivalent to absolute intelligence, or else conviction is no test of truth, and knowledge is supposititious. But this equivocal postulate is wholly gratuitous. The apparent dilemma it entails is forced and repugnant to reason. Common-sense, the vulgar appellation of natural faith, forestalls it. Every sentient being declares by actions — which proverbially speak louder than words — that knowledge is a reality; that the faculties of cognition, though relative and finite, are implicative of absolute efficiency within the scope of their normal exercise: this, too, coincidently with the consciousness that the verdicts of sense and reason are involuntary and extraneous to selfhood. Moreover, it is a fact of introspective observation that natural faith, to use a figure of speech, is the alphabet of knowledge; and, as words are composed of letters, so are perceptions composed of truisms. Furthermore, as a syntactic collocation of words constitutes a proposition, so a certain correlation of perceptions constitutes an axiom, a thesis, or a descriptive thought. It thus appears that knowledge is not only based upon natural faith, but is born out of it, and in a manner to consist of suscitated elements thereof: so that intelligence, in the broad sense of the word, may be regarded as a multiplex synthesis of truisms.

Now, what is the goal of reasoning in this direction, if not this: that auturgic knowledge is in no wise an attribute of mentality; that the ability of sentient beings to *know* or discover truth is virtual, not actually self-exerted; the intellect being made to operate, through overt incentives, by an occult, exogenetic suasion. This is Natural Faith, imputable to no other agency than that of the Author of Nature and Parent of Mentality, the Infinite Mind, whose Omniscience is of necessity, by whom and wherewith all sentient beings are inspired as freely as with life and as impartially as befits the gradations of development, *only through experience.* And experience justifies this assertion of the nominal cognoscence of all sentient beings. Are we not conscious of the passivity of our affectional nature? Are we not subject to supervening pleasure or pain according to sensible environments not always of choice? Are we not at times possessed of emotions and even desires which are irresistible? Is not consciousness thrust upon us in the unwelcome as well as welcome scenes of experience? Why should the rational department of mentality obtain by a different law of Nature from that which determines the character of our appetites and aspirations? No wonder that we cannot *see* other than the objects of sight, nor see to the best advantage without seeing things as they are; nor is there cause for wonder that mental vision is as rigidly governed by law as its physical precedent.

But how does this revelation affect our estimate of reason and the enthusiasm of would-be sages? In no wise adversely. The discovery that conviction is suscipient — that man knows nothing as an auturgic agent of cognition, does not warrant the inference that what he instinctively seems to know is of no account. It remains a certainty that knowledge is conviction of truth; and conviction is a word of intuition — the provisional name for an occult tribunal of thought whose verdict is final. Intuition is otherwise designated as *Instinct;* and this word is less objectionable, as being devoid of fallacious implication. If the principle were understood, its appropriate name would express a subjective impress, due to *communion of the Infiite Mind with mentality* in all its phases, as well as with every species of living organisms. Instinct as thus conceived is characteristic of evolution in every physiological stage of its process. It is the soul of existence, — the utilizer of Force in the physical and physiological operations of Nature so-called, and the mediator or virtual agent of all involuntary achievements in the animate world. Instinct is infallible, *because* it represents MIND, whose living scripture it is, which we merely read and call our reading knowledge. Let it smother vanity. It is no disparagement of sense or reason; it exalts our estimate of both as attributes of human nature, and of all sentient nature, to be mindful of the philosophic discovery that what we know, or only seem to know, is God's own word of truth.

IX. *As to the purview of finite intelligence.*

Of the Infinite Mind nothing is known or knowable but by inference from the patent works and offspring thereof, whose aggregate is Nature the crown of which is *personality*, — not as phenomenally manifest, but as commended by the human ideal of its ultimate. This — the most cherishable want of human nature, the proper paragon of personal character — is the best attainable expression of the Infinite Mind. Yet the discrete truth here asserted is commonly missed by ardent students of overt Nature, whose interest in the mere sight of her features prevents an equal insight of their auspicious implications. This is the rationale of atheism and materialistic negations of evidence touching human destiny. The conventional scientist comprehends little more of Nature than is thrust upon reason by the external organs of sense. He quite ignores, in effect, that unobtrusive world of realities which is revealed exclusively by the brain-organs of introspective observation. The fruits of sensible experience he regards as the sole elements of intelligence. Experience is, indeed, the mother of science, but also of a certain higher grade of intelligence resulting mainly from the issues of science. The justness of this discrimination is inceptively brought to light, or at least rendered credible, by reflecting —

1. That reasoning is the complement of observation in every act of perception: the five senses, so-called, being the mere implements of sense.

2. That the inception and process of thought are both instinctive; so that, in rational investigation, the subject only is elective, whereof the judgment (if logical) is compulsory and inevitable.

3. That all problems are solved and all propositions tested by discovering their relation to certain truisms, or unwitting assumptions which qualify the organs of intelligence; these having, respectively, one and the same bent of intellective purpose and the same scheme of collocation, verifying the same conventional agency in every grade of mentality.

4. That the constituents of progressive mentality are classifiable according to their specific functions and order of development as pertaining distinctively to three categories of consciousness, namely: (1) that of Natural Want, (2) that of Natural Faith, and (3) that of Natural Right, otherwise distinguished as the affectional, the rational, and the moral sensibilities.

5. *That Natural Faith is the pedestal of all finite intelligence.*

6. That what validates *natural faith* is its preter-rational genesis, it being an issue of *Natural Causation* whose supernatural agent is *Absolute Mind*, the Author of all finite susceptibilities.

Scientists claim that nothing is knowable but by observation and induction from the facts of sensible (or conscious) experience. But experience itself becomes sensible, or its facts become cognizable, only through an instinctive and unconscious assumption of —

1. *The reality of existence* (distinctively as to selfhood and its environment).

2. *Reliability of the senses and intellective faculties*,

as avenues and agencies of perception, so that *whatever is perceived to be* VERILY IS *what and as it is perceived to be.*

So much of natural faith is prerequisite to the inceptive intelligence even of brutes. To these elements thereof must be added for the beginning of science —

3. *The continuity of existence and the undeviating course of Nature*, or sequence of cause and effect, in the past, present, and future, as determined by the fixed character and correlation of its physical elements and forces; these being the imbodiments of natural law, in effect of which *the lessons of experience at any time become practically useful for all time.*

No inductions of science are better established than these self-evident truths, which are so-called because they do not admit of demonstration, yet are indisputable and indubitable. They are instinctive; and make what we will of Instinct, or set at naught, as we may in words, the authenticity of Natural Faith, we are rationally assured that science is superstructed thereon, and, therefore, that, if these prime elements thereof are fallacious, science itself is imaginary and human intelligence merely simulative. It is in the light of this dilemma, or in view of its only possible disposal, that the validity of Natural Faith is apprehended; and this apprehension is the stair-step from the plane of scientific to that of philosophic intelligence. For the basic elements of philosophy, as constituents of Natural Faith, must be co-ordinate in purpose and prestige with those of science, making the lessons of insight or introspective observation of the same validity as those of sight or extrospective observation. But these pertain exclusively to existence, whereas those savor of existence only with regard to its *anterior cause and ulterior use*, as represented by the subjoined axioms:

1. That no entity can be either self-made or self-sustained.
2. That every entity is either of necessity or a product of causation.
3. That causation, the act (including the means and method) of causing something to be that was not, requires a causal agent.
4. That the products of causation are in all cases significant of the character of its agent.

From these truisms, it is within the province of reason to deduce an equivalent of the following propositions:

1. That all agents of causation are voluntary.
2. That no agent of causation can act without a purpose.
3. That causation is never effected without a use germane to the purpose of its agents.
4. That the character of *the Infinite Mind*, the certified *agent of natural causation*, is adumbrated by the human ideal of personal excellence.
5. That the extant process of mundane existence implies a use corresponding in grandeur to the conceived magnanimity of its supernal agent.
5. That the paramount use of existence when attained must be sempiternal.
7. That the purpose of THE INFINITE MIND, to be wrought out in the process of existence, is the generation and education of immortal persons, the use of whose conscious being shall culminate in HAPPINESS such as must accrue from the progressive ability of each to commune with all and with the Author of all Good.

Here I cut short the recapitulation of my aforeclosed essay. The subject of this book is exhaustless and hardly fathomable. The ninth topic of its last chapter outlines an unlimited optional discussion. Supplemental topics, cognate to those treated, are emergent in thought and would be legitimately entertained; but enough has been said to vouch the scope of my title-page, even to its terminal clause. *The Pericosmic Theory*, as the germ of Cosmology, is preliminary to the coälition of special sciences relevant to the integrity and utility of Science Proper as the base of Philosophy Proper; and the Sequel thereof, as set forth in chapter XV., is the index to Philosophy Proper as identified with the *Teleology of Mundane Existence.* But the feasibility of *Biologic Teleology* has been disputed. Have we any assuring evidence that this soul-craved object of Natural Want is attainable? It is pledged by the concept of its cognate element of Natural Right, and its attainment is warranted by the paramount lesson of Natural Faith that *whatever ought to be either is or is to be.*